FINAL

AMENDMENT #4 and

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

to the

SEA SCALLOP FISHERY MANAGEMENT PLAN

July 1993

Volume I

Prepared by

New England Fishery Management Council

in consultation with

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South Atlantic Fishery Management Council

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1. Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry. 189
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4. Conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an

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III. SUMMARY

A. Background

The New England Fishery Management Council proposes to amend the Fishery Management Plan for Atlantic Sea Scallops, Placopecten magellanicus (Gmelin) initially implemented on May 15, 1982. The objectives of the plan are:

1) to restore adult stock abundance and age distribution;
2) to increase yield per recruit for each stock;
3) to evaluate plan research, development and enforcement costs; and
4) to minimize adverse environmental impacts on sea scallops.

The management unit consists of the sea scallop resource throughout its range in waters under the jurisdiction of the United States. This includes all populations of sea scallops from the shoreline to the outer boundary of the Exclusive Economic Zone (EEZ). The principal resource areas are the Northeast Peak of Georges Bank, westward to the Great South Channel, and southward along the continental shelf of the Mid-Atlantic.

The management unit also includes populations found within the Gulf of Maine and Cape Cod Bay. These areas include the territorial seas throughout the range, primarily in ME and MA. Fishing for sea scallops within state territorial waters is not subject to regulation under the FMP except for vessels that do not hold a federal scallop permit when scalloping in state waters. Nonetheless, populations within state waters are included within the management unit in recognition of market interactions and the need for complementary state management action.

Five resource areas are generally defined within the management unit: Delmarva, New York Bight, South Channel and Southeast Part of Georges Bank, Northeast Peak and Northern Part of Georges Bank, and the Gulf of Maine (Wigley et al. 1991, Wigley and Serchuk 1992). The Delmarva area includes scallops as far south as NC.

Scallops are broadcast spawners and spawning generally occurs throughout the range. No biological evidence exists to indicate discrete stocks exist (NMFS 1992b). Although the major resource areas tend to be geographically isolated, sea scallop eggs and larvae are planktonic and can be transported long distances (Posgay 1979, Serchuk et al. 1979, Serchuk 1983). There is no evidence to suggest that localized spawning provides sufficient recruitment to produce self-sustaining, independent populations (Squires 1962, Naidu and Anderson 1984). It is possible, however, that some isolated aggregations of scallops may contribute very little to the overall reproductive potential of the resource.

Survey data show large geographical variations in abundance which are not correlated, but

highly mobile fleets, and a lack of reproductive isolation argue strongly for uniformity in the management program.

The management measures within the original plan included a 30 average meat count standard, a 3½ inch minimum shell height standard, and a temporary adjustment of standards. The plan took effect on May 15, 1982 through emergency rules. The 1982 meat count standard was 40 meats per pound for shucked scallop and a minimum shell height of 3¼ inches for scallops landed in the shell. These measures remained in effect during a one-year phase-in period, after which the measures were to be adjusted to 30 meats per pound and a 3½ inch shell height standard. In June 1983, the Regional Director invoked the Plan's temporary adjustment provision and set the meat count at 35 meats per pound and shell height standard at 3**?** inches. These restrictions remained in place until a Secretarial amendment was implemented.

Amendment #1 to the plan proposed a 40-meat count (scallop meats per pound) minimum size throughout the fishery and was approved on October 9, 1985. It was never implemented.

Amendment #2 was approved in June 1988 to provide a 10% increase in the meat count standard during October through January when spawning causes a reduction in individual meat weight, and a framework mechanism to adjust the meat count standard during the spawning season. It became effective on July 22, 1988.

Amendment #3 established regional 12-hour time periods (offloading windows) for off-loading sea scallops. It became effective on February 5, 1990.

Amendment #4 proposes to change the primary management strategy from the current meat count (size) control management system to an effort control program for all resource areas. The discussion of alternative approaches to the meat count standard began with public hearings on Amendment #2 (June 1987). Those alternatives included a 3½" shell height throughout the fishery, staggered area closures, seasonal closures, modifications to the meat count standard and gear restrictions.

At the inception of Amendment #4, the Council held scoping hearings during February-March 1989 on six industry proposals to replace the meat count standard. Those proposals included combinations of the following: annual declaration of intent to participate in the fishery, licenses for scallop vessels, a maximum crew size of nine, a call-in program for landing fishing trips, an annual target quota, trip catch limits, layover day (time between trips) limits, a meat count with gear restrictions, landing time restrictions and data reporting requirements. These scoping hearings were held at Ellsworth, ME; New Bedford, MA; Cape May, NJ; Norfolk, VA; and New Bern, NC.

The Council voted to establish March 2, 1989 as a control date for any limited entry, moratorium, or other allocation scheme in the scallop fishery. It was intended to be used for any of several alternatives which may be developed under Amendment #4. Subsequently, the Council extended the qualification period for newly constructed vessels to the end of 1990.

Public hearings were held in December 1990 to receive comment on measures proposed for Amendment #4. These measures included, 1) trip limits, layover days, a target quota, and a moratorium (the preferred alternative at that time); 2) a modified meat count regulation combined with effort controls; 3) closed areas; and 4) individual transferable vessel allocations. Six hearings were held at Ellsworth, ME; Portsmouth, NH; New Bedford, MA; Cape May, NJ; Hampton, VA; and Morehead City, NC. As a result of those hearings, the Council changed its preferred alternative from catch per trip and layover day limits to one which uses days at sea controls as a primary measure.

Additional public hearings were held in early March 1993 to receive comments on the draft amendment #4 and the draft SEIS. The Council also accepted written comments on the SEIS from December 24, 1993 until the official close of the comment period on February 23, 1993. Subsequent comments were accepted through the close of the comment period for the draft amendment on April 26, 1993. The public was notified of these hearings and, prior to the hearings, all scallop permit holders were informed of their automatic qualification or disqualification based on the existing data. If they qualified, the notification also stated which category their vessel would be assigned under each of the proposed alternatives. The six public hearings were held at Cape May, NJ; Hampton, VA; Washington, NC; Hyannis, MA; Ellsworth, ME; and Fairhaven, MA.

In general, most commentors were concerned with the moratorium, the criteria being proposed to qualify vessels, and the mechanisms being proposed to allocate days at sea. If adequate changes were made to the proposed management program, many fishermen supported the preferred alternative over the other three alternatives intended to replace the meat count regulation. The current meat count regulation was vigorously opposed in New England and these fishermen urged the Council to expedite Amendment #4. Fishermen in the Mid-Atlantic had the same concerns about the basis for effort allocation, but did not state as much opposition to the meat count regulation.

Fishermen whose scallop vessels did not automatically qualify were opposed to the moratorium. They believed that the proposed appeals procedure would not satisfy their claims of being in the fishery during the qualification period (March 2, 1988 to March 2, 1989). More recent entrants to the scallop fishery felt excluded despite their full-time participation since the control date. Fishermen currently in other fisheries also opposed the moratorium because they did not want to lose the option of entering the scallop fishery in the future. The Council responded to these comments by 1) allowing qualification of

vessels that changed ownership between the control date, March 2, 1989, and November 28, 1990, when fishermen were notified that future participation would be based on a specific period and 2) allowing more liberal and equitable rules for review during appeals, including a provision for industry participation in the process.

Many fishermen also stated that their initial automatic qualification was not accurate. They felt that the voluntary data collection system used to qualify vessels and missing records contributed to the mis-classification. Many were concerned with their ability to document former fishing activity during the appeals process. Other fishermen felt that they were mis-classified because they did not fish for other species and were full-time scallopers despite lower fishing activity. For example, some vessels fished at a full-time level in the last year of the qualification period, 1990, but were classified at lower levels because of reduced fishing activity in earlier years. Other vessels were classified at lower levels because they entered the scallop fishery late in the 1985-1990 period and had a partial year of data which dragged their average down. Some vessels scalloped at a full-time level following a change of ownership, but they were classified at lower levels because of a former owner's scalloping history. The Council responded to these concerns about the equity and fairness of the allocation mechanism by making the following changes to the group assignment rules: 1) vessels would be classified by the higher of their 1985-1990 days at sea average <u>or their 1990 total days at sea</u>, 2) partial years when a vessel began scalloping would be prorated to a full year, and 3) owners may request that a vessel's scalloping history under a former owner be disregarded. Similar to the above moratorium requirements, the appeals process for incorrect vessel assignments was liberalized to allow easier documentation of former participation.

Lastly, Gulf of Maine fishermen commented that their historical practice of scalloping in state waters and occasionally at Fippennies Ledge and Georges Bank with smaller dredges was not taken into account. Furthermore, they argued that incomplete data collection and difficulty in documenting their complete scalloping history would result in mis-classification. The Council responded by modifying the group assignment rules, the gear size restrictions, and the crew limits. Vessels would be allowed to qualify for a single category increase in days at sea allocation if they continue to use the smaller, 10.5 feet dredges throughout the year and carry a crew of no more than five while scalloping.

B. Proposed Alternatives

Proposed Amendment #4 significantly alters the way in which Atlantic sea scallops are managed. In place of the current meat count controls, Amendment #4 proposes to control aggregate fishing effort through limited access and a schedule of aggregate effort reductions. In two alternatives, fishing effort is controlled via direct allocations of allowable time at sea.

A third alternative indirectly controls effort by setting trip limits determined from standing stock levels and target fishing mortality rates. The fourth alternative imposes limits on time at sea by increasing layover periods between trips when vessels must remain in port. If set correctly, trip limits will cause fishermen to shorten trips. When coupled with a fixed layover requirement, these trip limits will reduce fishing effort.

All four alternatives have supplemental measures designed to limit increases in a vessel's fishing power, hence control the amount of fishing pressure associated with a day at sea. These measures include gear restrictions, catch limits for vessels not in the limited access fishery, and a moratorium to control the number of vessels in the fleet. The following table summarizes the various alternatives that were considered within the draft plan and the draft SEIS. The measures contained within the preferred alternative are shaded. Some measures have been added or modified to respond to public comments. The measures to be included in the proposed action are shaded.

Management Alternatives
Moratorium: **1. Vessels must have held a federal scallop permit and have landed scallops between January 1, 1988 and December 31, 1989.** **2. New or re-rigged vessels must have obtained a permit and landed scallops between March 2, 1989 and March 2, 1990.** **3. Vessels that changed ownership between March 2, 1989 and November 28, 1990 must have had a scallop permit and landed scallops during 1982 to 1988 and have landed at least one trip in excess of 400 pounds of scallop meats during 1990.** **4. Annual declaration required between October 1 and December 31 for the next year. Failure to declare would prohibit future participation in the directed scallop fishery.** **5. Appeals must be in writing and appellants may request an oral hearing. Appeals will be based on criteria acceptable to the Regional Director and an appeals board. Appeals will be limited to one year following implementation.** **6. Evidence for appeals are:** **a. State landings data** **b. Pack-out forms or settlement sheets** **c. Other proof, such as canceled checks or signed affidavits from dealers.**
Effort Reduction Program: **1. Effort is measured by the total days at sea in cumulative hours accrued by qualifying vessels. Effort would be reduced so that fishing mortality falls as scheduled to the overfishing threshold by year 7.** **2. Evaluation of fishing mortality will be made during years 3 and annually thereafter. Adjustments to days at sea will be scheduled during years 4 through 7, after a four month notification.**
Assignment to Effort Allocation Groups: **1. Based on recorded days at sea for directed scallop trips between 1985-90, or optionally based on 1990 if a higher classification results. Partial years of landings due to entry into the fishery will be pro-rated to a full year based on evidence showing the date of entry. At the owner's option, only a new owner's history will be used if there was a change of ownership between 1985-90.** **2. Vessels that qualify under moratorium provision 3 will qualify for a category no higher than that for which they would qualify using the average of the 1991-92 history.** **3. Vessels permitted under the 10'6" dredge exception will be classified one step than classified under #1 and #2.**

Alternative I	Alternative II	Alternative III	Alternative IV
Days at Sea **3 Groups** **3 vessel groups:** **Full-time (at least 150 days),** **Part-time (more than 37 days and less than 150 days), and** **Occasional (37 days or less).**	**Days at Sea** **22 Groups** **22 vessel groups:** **Two tonnage classes, and** **11 fishing categories with a 25 day range.**	**Adjustable Trip Limits** **Fixed Layover** **2 vessel groups:** **Full time (at least 150 days), and** **Part-time (less than 150 days).** **Six day layover throughout all years.** **Target yield allocation:** **80% to full-time,** **15% to part-time, and** **5% reserve for appeals and boats landings scallops under the 400 pound trip limit.** **Annual adjustments to trip limits based on target fishing mortality and expected stock size which predict a target yield.** **Landings reporting and monitoring via bar coded bag tag system**	**Fixed Trip Limit** **Adjustable Layover** **2 vessel groups:** **Full time (at least 150 days), and** **Part-time (less than 150 days).** **Fixed 10,000 pound (meats) trip limit.** **Allocation of total days at sea:** **74% to full-time,** **26% to part-time.** **Landings reporting and monitoring via bar coded bag tag system** **Optional season for part-time group.**

Management Alternatives (cont)

Supplemental Measures:

1. a. **Maximum crew size of nine, including the captain.**
   b. **Maximum crew size of five, including the captain for vessels permitted under the 10'6" dredge exception**
2. **Annual permits and mandatory data reporting for owners, dealers, and brokers. Captains will be required to obtain a permit valid for no more than three years. Changes to permit information must be reported within 15 days. Ownership interest of limited access permits restricted to no more than 5% of the permits issued at implementation, including appeals.**
3. **Prohibition on onboard shucking and sorting machines for shucked scallops.**
4. **Prohibition on at-sea transfers of scallops.**
5. **3½ inch minimum shell height standard for shell stockers.**
6. **400 pounds of meats or 50 U.S. bushel of shellstock possession limit for non-qualifying vessels**

Dredge Restrictions:

1. 3¼ inch minimum ring size in years 1 and 2.
2. 3½ inch minimum ring size after year 2.
3. a. 30 feet limit on the total width of all dredges.
   b. An optional 10 feet, 6 inch single dredge for vessels permitted to receive higher days at sea allocations
4. Prohibition on chafing gear, cookies, more than double linking, or other obstructing devices.
5. 5½ inch minimum mesh twine top.

Trawl Restrictions:

1. a. 5½ inch minimum mesh for vessels scalloping north and east of Hudson Canyon.
   b. 5 inch minimum mesh for vessels scalloping south and west of Hudson Canyon.
2. 144 feet trawl sweep limit.

Data Collection:

1. a. Effort monitoring via mandatory transponders for full-time vessels. Full-time vessels must operate the transponder at all times.
   b. Effort monitoring via transponders or a call-in program for part-time and occasional class vessels. If monitored via transponders, operation for 365 days per year is not required.
2. Landings and effort data reporting via a system to be determined by the Regional Director.

Optional Measures:

1. Continuation of meat count standard which replaces requirements for:
   a. Increases in dredge ring size above 3 inches.
   b. 5½ inch trawl mesh.
   c. 5½ inch mesh twine top.
   d. Prohibitions on chafing gear, cookies, more than double linking, and other obstruction devices.
2. 3 inch minimum ring size in years 1 and 2 with adjustments to effort controls and/or trip limits.
3. Effort monitoring through sign-in/sign-out procedure
4. 12-hour offloading windows.

C. Major Conclusions

Each of the proposed alternatives includes some form of direct or indirect means to reduce fishing mortality to levels necessary to avoid drastic declines in scallop recruitment. The current fishing mortality will be reduced 35-70% over seven years so that fishing mortality will remain below the overfishing definition rate ($F_{5\%}$). Pauses in the mortality reduction program are scheduled for the third and sixth years to evaluate the effectiveness of the restrictions. Failure to reduce fishing mortality or increases in partial recruitment (reduced size in the catch) will result in greater effort reductions. Conversely, greater than expected fishing mortality reductions and effective supplemental restrictions will result in less effort reductions.

The seven year mortality reduction schedule, and the associated effort reduction program, is a compromise between the recovery rate and minimizing the economic and social disruption to the fishery.

If no action is taken at this time and if recruitment fails to remain at the currently high levels, stock levels will fall rapidly. Moreover, the high rate of exploitation is well above the overfishing definition and the risk of recruitment failure is unacceptably high. Although the gross stock for some vessels in the fleet may be the same or higher than former levels, larger vessels fishing more frequently have increased fishing pressure. Due to the doubling of effort since the last peak in landings (1979), catch per unit of effort has

declined.

The proposed management measures with the greatest environmental impact are the moratorium, effort reduction, and increases in minimum ring size. Because lower fishing mortality is expected to produce higher yields after year four by increasing yield per recruit, net benefits under all effort reduction alternatives are positive.

Since the moratorium will limit the number of vessels in the fishery, and effort reduction will reduce their variable costs, catch and revenue per unit cost is expected to rise significantly unless recruitment falls to low levels. If recruitment falls substantially, a large number of vessels will not be profitable and will cease to fish for scallops. Since yields are higher and costs are lower to vessels under the proposed alternatives, less vessels would become uneconomic than under the No Action alternative.

Of the vessels that had directed trips for scallops in 1991, 151 of those do not qualify under the moratorium rules. Most of these vessels derive a small part of their fishery income from scallops. Their loss of scallop income is likely to be replaced by catches of other targeted species. Thirty-four vessels derive a large portion of their income from scallops. The Council anticipates that some of these vessels are replacements for qualifying vessels that did not fish for scallops in 1991. These vessels and any that are not well represented in the NMFS weighout data base may enter the scallop fishery through the appeal process. The remaining vessels will fish for other species. Some of this effort probably will shift to unlimited fisheries or unregulated species, such as squid, mackerel, butterfish, and goosefish. Some vessels have a history of fishing for summer flounder and groundfish. To the extent possible, these vessels may increase fishing pressure on these species.

The moratorium will benefit the scallop resource by making it easier to control fishing effort and will benefit current participants by increasing catch per unit effort. On the other hand, the moratorium is likely to displace some boats from the fishery. This will have negative economic consequences for these vessels and will probably impact other regulated and unregulated fisheries.

The effort reduction program will limit the time vessels may spend at sea fishing for scallops. With the exception of the alternatives having fixed layover periods, the program does not prevent vessels from fishing for other species. Since effort reduction is substantial through the seven year program, it is likely that vessel operators will redirect some effort to other species. Many of these qualifying vessels have a history of catching groundfish. In addition to the above unlimited and unregulated fisheries, these vessels probably will increase fishing on groundfish and summer flounder if rules under those plans allow them access to the fishery.

Effort reduction also will have beneficial impacts on associated species and by reducing by-

catch. Since fishing time will be reduced, discard mortality rates on non-directed species will be reduced from current levels.

The ring size controls will result in substantial short-term declines in catch. While this will contribute to economic impacts, the rapid growth rates of young scallops will quickly increase yield per recruit. For example, a three year old scallop can double its meat weight in six months. If, as expected, the ring size restriction and the supplemental measures are effective in reducing the catches of young scallops, they will diminish the need for large effort reductions.

Although the proposed 3½ inch ring size is substantially smaller than the 5½ and 6 inch mesh used by trawls for demersal species, the proposed ring size increase is likely to improve escapement by other species as well as scallops. Other supplemental measures, such as 5½ inch mesh twine tops, elimination of chafing gear, restrictions on linking, and a 30 foot maximum total dredge width are likely to have beneficial effects through the increase of escapement and reductions in unwanted by-catch. Unfortunately, studies of catches, escapement, and habitat impact by the proposed gear restrictions are absent.

Because of their propensity to uptake trace metals, sea scallops are readily contaminated in areas of ocean dumping making their marketable meats and gonads unacceptable for human consumption. Scallops appear to be particularly susceptible to sources of cadmium and copper. Contamination of scallop beds by trace metals can cause adult scallop mortality and can affect the reproductive physiology of sea scallops, thus increasing the probability of poor recruitment.

Ocean mining can remove suitable substrate for sea scallop spat settlement, affect larval development and adversely affect the reproductive, respiratory and feeding physiology of adults. Although the effects may not be as severe in an open system, in a closed system like Georges Bank they could be critical.

Sediment extraction in areas having significant levels of scallop populations should be avoided. Suspended sediments arising from the extraction can have chronic sub-lethal effects on essential biological processes, such as feeding and respiration. Since sea scallop spat do not settle on fine sediments, the accumulation of fine sediment on the sea floor may decrease recruitment resulting in low abundance.

There are very few demonstrated instances of habitat degradation caused by fishing. Although there have been some decreases in mesofaunal and aerobic speciation following dredging, several areas with notable levels of fishing effort have not exhibited declines in later recruitment of scallops. Although some dislocation of fishermen and a redirection of fishing effort is expected, reduced fishing effort by scallopers is expected to reduce the by-catch of finfish and associated benthic species.

D. Areas of Concern

There are three areas of concern over the proposed alternatives, the moratorium, the number of groups for days at sea allocation, and how days at sea will be monitored. These concerns were expressed at numerous meetings, and the Council has given serious consideration to them.

The moratorium is based on a previously adopted control date for the scallop fishery. Since some form of limited entry and / or effort reduction was a possibility under Amendment #4, the Council gave new entrants notice that they were not guaranteed future participation in the fishery. Despite this notification, a significant number of vessels will be disqualified from future participation.

About 150 vessels identified through the 1991 weighout data base do not qualify under the moratorium rules. These rules allow for appeals and the Council anticipates that many vessel owners will successfully document their participation in the directed scallop fishery prior to December 1989 (March 2, 1990 for new or re-rigged vessels). Other vessels are simply replacements for vessels that qualify under the moratorium and will be admitted to the fishery through the appeal process. It is not known how many of these vessels will successfully appeal until the appeal process is completed.

The Council considered a days at sea reduction program with up to twenty-two vessel classes based on GRT and historic participation. The Council's Plan Development Team recommended these groups and the method to be used to classify vessels because it felt that the data for the scallop fishery was adequate for this purpose, that the twenty-two classes would not overly penalize or reward individual vessel operators, and that fewer appeals would occur. The latter opinion was based on the size of the award for a successful appeal and the amount of data that might be missing in the data base.

The Council's Industry Advisory Committee recommended fewer vessel groups, based on the lack of comprehensive landings data and a desire to establish equal participation under the amendment. They recommended two groups, a full-time class with histories of 150 or more annual days at sea and a part-time class with less than 150 days at sea. Further discussions revealed a large number of seasonal operators with much lower days at sea histories. These vessels would be rewarded by granting them as much as 97 days at sea in the first year of the program. As a compromise, the Council adopted a three class system of occasional, part-time, and full-time vessels.

The NMFS weighout data base will be used to automatically qualify vessels in the scallop fleet. Although it is a voluntary data collection program, approximately 80-90% of the sea scallop landings are recorded through the system. Many vessels, especially at large ports like New Bedford, MA and Hampton, VA, have most their landings recorded in this file. A

lenient appeals process and realistic goals for using the weighout data to classify vessels have been proposed in the preferred alternative.

Under all alternatives total revenue is expected to decline for the first four years relative to the No Action alternative. Continued effort reduction until fishing mortality falls below the overfishing definition threshold will produce higher returns and lower non-wage variable costs than the No Action alternative. The net present values of the proposed alternatives are positive. Just as important, the proposed action will reduce variable costs through effort reduction. Coupled with the expected increase in yield, the catch per unit of effort and cost is expected to increase 75 to 200 percent.

If other regulated fisheries (primarily groundfish and summer flounder) have sufficient controls to limit increased fishing effort by occasional or new participants in those fisheries, Amendment #4's impacts will be negligible. Since Amendment #8 to the Surf Clam and Ocean Quahog FMP (MAFMC 1988) uses individual transferrable quotas (ITQs) to manage the resource, scallop dredge boats could only enter that fishery by purchasing rights to fish. In this case, no harm to the surf clam resource will occur.

Other fisheries with no or marginal restrictions, such as goosefish, squid, Atlantic mackerel, and butterfish, may face increasing fishing effort. This is problematic for goosefish, because the species is thought to be fully exploited and might be overfished (NMFS 1992a). The New England Fishery Management Council is starting to develop an FMP for goosefish. The other species are under regulation (MAFMC 1991), but only mackerel is believed to be underutilized or at a low level of exploitation (NMFS 1991b, NMFS 1992a). Increased fishing effort on mackerel may have a positive economic impact with limited impact on the environment. However, a control date that limits speculative entry into the fishery has been published during 1992 for the Squid, Mackerel, and Butterfish FMP.

E. Mitigation

There is no evidence that any of the proposed alternatives will have a significant detrimental effect on the environment. In addition, there is little documented evidence of interactions between protected species and fishing for sea scallops. Since this fishing activity is confined to cooler offshore waters (especially in the southern portion of the sea scallop range), mortality on sea turtles is believed to be minimal. As a result of the consultation required by Section 7 of the Endangered Species Act, NMFS has concurred that the fishing operations conducted under the amended FMP are not likely to adversely impact endangered or threatened species under the jurisdiction of NMFS (Appendix IX). No mitigation measures therefore are required at this time.

IV. PURPOSE AND NEED

A. Over-exploitation

The current Atlantic sea scallop FMP relies on one type of measure, size controls which include the 30 average meat count standard for shuckers (the 3½" minimum shell height standard for shell-stockers), to control fishing mortality primarily on small scallops. Further, the use of an average meat count minimum rather than a clearly defined size limit has required complicated procedures to monitor, enforce, and prosecute violations of the meat count standard.

Amendment #4 has been under development for over five years to address a number of problems with meat count controls and to improve yield per recruit and maintain acceptable stock biomass levels. Although recruitment of small scallops to the Georges Bank and the Mid-Atlantic stocks has been moderate to excellent in recent years, fishing mortality has been high. Despite the meat count standard, recruiting scallops are caught soon after reaching harvestable size. Thus the current fishery is dependent largely on one or two year classes of recruiting scallops. Fishing at the current rate is expected to eventually drive the stocks to low levels, because record high recruitment will probably not continue.

If recruitment declines to previous levels, the current rate of fishing mortality is unacceptably high to avoid substantial declines in the spawning stock. Such an event could take many years to recover from and would cause severe economic dislocation and hardship. Pursuant to federal guidelines (50 CFR § 602) for fishery management plans, the Council has developed a measurable overfishing definition for sea scallops.

This definition is based on a rate of fishing that will produce a spawning stock biomass of five percent of an unfished population at equilibrium (5% MSP). Although this spawning stock biomass is low compared to other marine species, the Council's Plan Development Team believes this level to be sufficient because of high fecundity and rapid rates of maturation and growth of scallops.

The fishing mortality that will produce a 5% MSP with 3½ inch dredge rings is estimated to be 0.97 (60% annual exploitation). The most recent assessment by NMFS (NMFS 1992b) estimates current fishing mortality to be 1.5 to 1.8. The resource-wide estimate is 1.63-1.69, depending on how fishing mortality is weighted between stock areas. Current fishing mortality is substantially higher than the overfishing definition (Figure 1).

To eliminate overfishing, the current assessment implies that an effort reduction of 40 percent is needed. The Council proposes to eliminate the substantial overfishing over seven years. Because the effort controls and gear restrictions may not exactly translate into fishing mortality reductions and lower partial recruitment, the Council estimates that the

necessary effort reduction is between 35 and 70 percent. How much effort reduction is need will be continually re-evaluated, but special examinations of the effort / mortality relationship is needed during years three and six.

Both the 1990 and 1991 scallop catch of about 38 million pounds surpass the record landings of 1978 and 1979 (Figure 2). Moreover, the recent yields far surpass the long-term potential catch from the scallop resource. NMFS estimates this potential catch at 29 million pounds (13,300 mt, NMFS 1991b). Fishing effort in 1991 also set a new record, exceeding the prior levels during 1979 by 28,000 days fished (a 180% increase). These levels of catch and effort are not sustainable. Further, the Council's yield per recruit objective is not being met due to this high level of effort. Reductions in effort to the overfishing threshold will produce measurable gains toward this objective.

The selection of scallops on deck can result in delayed culling and unacceptable discard mortality. Reductions in fishing effort, larger dredge rings, reduced chafing gear and links, and larger meshes in the twine top and trawl gear will reduce finfish by-catch and associated mortality of benthic species.

B. Meat Count Enforceability and Acceptance

The meat count measure has been controversial for a number of reasons. Foremost among these is the difficulty fishermen have complying with the meat count and the problems enforcement agents have in determining compliance.

For fishermen the burden includes sorting and mixing of the catch at sea, a large amount of time spent searching for larger scallops, and other problems that may reduce product quality. Despite the efforts of fishermen to find, sort and mix the appropriate sized scallops, they are never certain whether a particular bag of scallops will pass the meat count requirements. Fishermen often use coffee cans to ascertain conformance with the standards while law enforcement agents use expensive, digital scales.

Fishermen also lower the meat count by soaking scallops in fresh water. This practice makes the scallops heavier through absorption, but can degrade quality and reduce prices paid to fishermen. The practice of mixing and soaking scallops causes some scallops to break into pieces, further reducing the value of the product. Sutenin et al. 1992 found that imported scallops contain a lower percentage of pieces than domestically landed product.

For enforcement agents the problems include a cumbersome and time consuming sampling procedure for hundreds of fishing vessels from ME to NC. There is also a widespread perception of unequal enforcement of the meat count measure across geographic regions. This problem is directly related to the limited number of agents and funds available for fisheries law enforcement.

The Council proposes to change fishery management measures from age-at-entry (meat count) controls to a fishing mortality / fishing effort control system. These measures will achieve a fishing mortality goal within seven years to levels consistent with the overfishing definition.

V. PREFERRED ALTERNATIVE

The preferred alternative would substitute a comprehensive effort control program and a moratorium for the present management system of meat count controls. The meat count standard was intended to restrict fishing mortality on small scallops (i.e., age 3 scallops which constitute the incoming or recruiting age-class). The preferred alternative will improve management through broad-based controls on fishing mortality for all scallop age classes.

This alternative will control fishing mortality by limiting the number of days vessels can spend at sea fishing for scallops and through other supplementary measures. The days at sea will be allocated to three groups based on a vessel's directed fishing effort during 1985-1990 or during 1990 only. Fishing effort will be reduced from current levels over seven years until current fishing mortality falls below $F_{5\%}$. In two pause years, mortality reductions are not scheduled and the Council will evaluate the linkage between total days at sea and fishing mortality. Adjustments to the proposed effort reductions may be made annually after year three.

Other measures (dredge and trawl restrictions, crew size, vessel upgrading, and shucking and sorting machines) will control fishing pressure generated by a vessel's day at sea.

A. Moratorium

A moratorium on scallop permits will cap the number of vessels that fish for scallops under the effort control program. This limit on participation is intended to accomplish two objectives. The moratorium will aid in controlling total fishing effort and will help to keep the current participants economically viable.

The moratorium will restrict limited access fishing permits for Atlantic sea scallops to vessels which had federal scallop permits and landed scallops more than 400 pounds of scallop meats or 50 U.S. bushels of shellstock on any trip recorded in either the 1988 or 1989 weighout data files or in state weighout files. Vessels that show proof of a change in ownership between March 2, 1989 and November 28, 1990, which landed any scallops from 1982 to 1988, and which landed one or more trips with 400 pounds of scallop meats or 50 U.S. bushels of shellstock during 1990 will also qualify. Other evidence that could be used as proof during appeal are state landings data, pack-out forms, settlement sheets and other corroborative proof such as canceled checks and signed affidavits. The moratorium will apply to all vessels which possess more than 400 pounds of scallop meats or 50 U.S. bushels.

New or re-rigged vessels will be qualify for the limited access fishery if they meet the following criteria: a) new vessels must have been under construction or re-rigging for

directed scallop fishing by March 2, 1989, or they must possess a written construction contract prior to that date; and b) they landed any amount of scallops and possessed a permit by March 2, 1990.
Vessels not qualifying for limited-access permits may apply for a general category scallop permit and will be restricted to possessing or landing no more than 400 pounds of scallop meats or 50 U.S. bushels of shellstock per trip. These vessels will be prohibited from landing more than 400 pounds of scallop meats or 50 bushels of shell stock within a 24-hour period. No more than one trip can be made within a twenty-four hour period.

B. Permits

Vessel Permits: Limited access permits will be issued under a vessel's U.S. or state documentation number. Permits may be transferred with the sale of the vessel, however, the vessel must remain in the same fleet category (occasional, part-time, full-time) or move to a lower category. Vessels may not move to a higher category through upgrading or a change in ownership. Scallop permits from different vessels may not be combined to increase the days at sea for a single vessel. No entity or individual may have ownership interest in more than 5% of the total number of scallop permits issued at implementation and through the appeal process.

To receive a federal scallop permit, vessels must annually declare their intent (by completing a permit application) to participate in either the full-time fleet, part-time, or occasional fleet. The application period will extend from October 1 to December 31 of the year preceding the fishing year. Vessels that fail to declare their intention for any year cannot re-enter the scallop fishery during the moratorium. Changes in information supplied for the permit must be reported to the Regional Director within 15 calendar days of the change.

Permit holders will be required to carry their permit aboard the fishing vessel during fishing and off-loading operations. It must also be available for inspection upon request by an authorized officer. The Regional Director may, after publication in the Federal Register, charge a permit fee for administration and enforcement.

Vessels that opt to fish in state waters for scallops according to state regulations may temporarily tender their federal permit to the Regional Director. That permit will be held by the Regional Director for the applicant's future use if he expresses his intention to re-enter the scallop fishery in the EEZ at a later date.

Vessels with limited access permits may be replaced, but it will be allowed limited increases in total effective fishing power and will remain within the same or a lower fleet category. Total effective fishing power will be controlled by restricting vessel upgrades

and replacements to less than a 10 percent increase in length, gross registered tonnage, or net tonnage, and a 20 percent increase in horsepower from the specifications found on the current scallop permit as of the implementation date. While the moratorium exists, each vessel will be limited to one upgrade. Vessels may move down in category.

Operator Permits: Operators of sea scallop vessels will be required to have a vessel operator's permit. No performance or competency tests will be required to obtain a permit. However, the permit may be revoked for violation of scallop fishing regulations. To address the amendment objective of improving administration and enforcement of regulations, the Council proposes to require that vessel operators be permitted as follows:

Any operator of a vessel fishing for Atlantic sea scallops must have an operator's permit issued by the NMFS Regional Director.

An operator is defined as the master or other individual on board a vessel who is in charge of that vessel. (Note: this definition is specified in the Code of Federal Regulations, CFR 50 part 620.2).

The operator will be required to submit an application, supplied by the Regional Director, for an Operator's Permit. The permit will be issued for up to three years.

The applicant will provide his/her name, mailing address, telephone number, date of birth and physical characteristics (height, weight, hair and eye color, etc.) on the application, and will be requested to provide his/her social security number. In addition to this information, the applicant will be required to provide two passport-size color photos.

Permit holders will be required to carry their permit aboard the fishing vessel during fishing and off-loading operations. It must be available for inspection upon request by an authorized officer.

The Regional Director may publish notification in the *Federal Register* and charge a permit fee for administration and enforcement.

Dealer Permits: To address the amendment objective of improving administration and enforcement of regulations, the Council proposes that fish dealers be permitted as follows:

Any dealer of scallops must have a permit issued by the Regional Director.

A dealer is defined as the person who first receives fish by way of purchase, barter, or trade. (Note: this definition is specified in CFR 50 part 620.2.)

The dealer will be required to submit an application, supplied by the Regional Director, for a dealer permit good for January 1 to December 31.

The applicant will provide the business name, the name of the person signing the application, mailing address, telephone number and principal place of business on the application.

The permit cannot be transferred and will expire upon change in ownership of the business.

The permit must be maintained at the place of business and be available for inspection by an authorized officer.

The Regional Director may publish notification in the *Federal Register* and charge a permit fee for administration and enforcement.

C. Effort Reduction Program

Two cases of high and low fishing mortality illustrate the proposed effort reduction program. Current fishing mortality is estimated to occur within this range. Table 1 gives a high base fishing mortality for 1990-91 and shows an effort reduction schedule if the current fishing mortality is underestimated or if days at sea reductions do not produce the expected declines in fishing mortality. The lower base fishing mortality (Table 2) is closer to current fishing mortality estimates and represents the probable initial effort reductions.

The derivation of target fishing mortality (F) is explained in Appendix I. The relationship between effort (days at sea) and fishing mortality will be reviewed during the pause years 3 and 6, and compensatory adjustments (either up or down) to the planned reduction schedule will be made as necessary. Annual adjustments to the days at sea schedule after year three are possible if the relative changes in fishing mortality and effort make it necessary. For example, there may be an adjustment to the effort (days at sea) reduction schedule (e.g., more than 9.5% each year using the low base F example), to achieve the linear reduction schedule in fishing mortality, if there is compensatory behavior by fishermen (i.e. to improve their effective fishing power per unit effort as days at sea reductions are imposed). Alternatively, there may be smaller reductions in days at sea in a given year (e.g., somewhat less than the 9.5%), if complementary measures and restrictions on productive capacity (i.e., crew size) prevent the expected gains in vessel productivity from being achieved.

1. Group assignment

Annual days at sea limits for all scallop vessels (both dredges and other gears) under the

moratorium will be allocated into 3 groups; full-time, part-time, and occasional. Vessels will be assigned to groups based on historical performance of the vessel. The rationale for this form of allocation is that all participants will be treated equally, while not pulling full-time operators down to part-time status and minimizing reliance on the voluntary weighout database.

Historical performance is based on the qualified vessel's average, annual days at sea during 1985-1990 (selection of years is described in Appendix II), as recorded in the NMFS weighout files. If a vessel has four or more years of history in the directed scallop fishery, the years having the highest and lowest days at sea will be omitted. When the vessels has three years of history, the highest and lowest years will be averaged and that result will be averaged with the remaining year. The annual days at sea will be averaged using all data for vessels having one or two years of history scalloping.

Vessels that qualify under the moratorium and whose 1985-1990 average as defined above falls within the part-time or occasional fleet definitions will receive higher classifications if their total 1990 days at sea qualifies at the higher level. In addition, vessels which changed ownership during 1985-1990 may, at the new owner's request, be qualified for a group based only on the history of the new owner. An owner may also show evidence (see section V.D.1) of the date of entry into the directed scallop fishery, and receive a full year's credit based on the prorated fishing activity during a partial year. Three vessel categories are defined:

Full-time fleet: Vessels must have averaged at least 150 days at sea (any 24 hour period or fraction thereof) annually, directed for scallops during the period 1985-1990 (selection of years is described in Appendix II) as recorded in the NMFS weighout files.

Part-time fleet: Vessels must have averaged more than 37 but less than 150 days at sea (any 24 hour period or fraction thereof) annually, directed for scallops during the period 1985-1990 as recorded in the NMFS weighout files.

Occasional fleet: Vessels must have averaged 37 days at sea or less (any 24 hour period or fraction thereof) annually, directed for scallops during the period 1985-1990 as recorded in the NMFS weighout files.

Each vessel in a group would be allocated the same number of days. During the 1985-1990 period, the 403 qualifying vessels had the following annual averages: 18 days at sea for the 113 occasional vessels; 87 days at sea for the 100 part-time vessels; 216 days at sea for 190 full-time vessels.

Limits on days at sea initially set based on the (dredge and other gear) fleet's performance

in 1990. The proposed schedule is shown in Tables 1 and 2. A more detailed description of the reduction of days at sea for the groups of *scallop dredge* vessels may be found in Table 1 of Appendix II.

2. Schedule

Fishing effort for the first year has been set by the Council based on the most recent fishing effort. If current fishing mortality (F) is higher than presently estimated (NMFS 1992b), subsequent reductions in days at sea could be, for example, 11.0% for year two, and 15.6% for years four, five, and seven (Table 1). The first year's allocations would be 201 days at sea for full-time vessels, 81 days at sea for part-time vessels, and 17 days at sea for occasional vessels.

Total days at sea in the fishery will be reduced by 11.0% in year two and by 9.5% in years 4, 5, and 7, with two pauses in years 3 and 6, to reduce current (1990) F of 1.50 to the target F of 0.97 (Table 2). Total days at sea were about 48,000 days in 1990, the starting point for effort reduction.

3. Re-evaluation of effort reduction

Days at sea adjustments via the framework mechanism will require a review of the effort/mortality relationship. This review will be completed following a formal biological assessment conducted by the Northeast Fisheries Science Center (e.g. at the Stock Assessment Workshop) during no less than July of the pause years. The formal review process will be completed within two months of the SAW. These adjustments will not be made until at least the end of year three and annually thereafter. The public will be given a 4 month notification of the pending changes in days at sea. The adjustment procedure (e.g., percentage adjustment allowed each year) will be recommended by the Council, the PDT and/or a SAW work group. These groups will consider recruitment, catch at age, changes in fishing behavior, and adjustments to either current or target F's.

D. Group Assignment Corrections

1. Data correction process

An initial round of review meetings will be established to correct data which qualifies a vessel for a fleet category. This round is intended to correct vessel effort data derived from the weighout system. The correction process will also make allowances for certain special circumstances which are outlined below. This review will be conducted by the Regional Director and may, at his discretion, involve local industry advice. Acceptable evidence of greater fishing effort will be determined by the Regional Director.

If a vessel owner shows documentation that the vessel entered the scallop fishery within a year between 1985 and 1990, inclusive, then the days at sea during that year will be increased (pro-rated) as if the vessel scalloped for the entire year. Because current owners might be unfairly penalized by a former owner's vessel history, the history for the current ownership will be used to determine the fleet category if this procedure is requested by the current owner.

2. Appeal process

Any applicant denied a permit or assigned to an incorrect group may appeal. The appeal must be made in writing within one year of implementation. The applicant will have a right to an oral hearing. Any of the following grounds may be used as a basis for review:

(i) The denial or group assignment was based on mistaken or incorrect information or data;
(ii) The applicant was prevented by circumstances beyond his/her control from meeting relevant criteria; or,
(iii) The applicant has new or additional information which might change the initial decision.

An appeals board will be established, but its composition will be determined by the Regional Director. Evidence that can be used as proof in the appeals process may include state landings, packout forms, settlement sheets and other corroborative proof such as cancelled checks and signed affidavits from dealers. Any form of evidence may be acceptable, but its approval will be made at the Regional Director's discretion.

E. Supplementary Measures

The supplementary measures are designed to limit increases in a vessel's fishing power, to provide some protection for small scallops and to control the amount of fishing pressure associated with a day at sea.

1. Crew size

All vessels that qualify under the moratorium will be restricted to a maximum crew size of nine while fishing for scallops. Qualifying vessels that are permitted under the 10.5 feet dredge exception will be restricted to a maximum crew size of five. These limitations include the captain and all personnel aboard the vessel while fishing. This restriction does not include other personnel, such as sea samplers, which are pre-approved by the Regional Director. Qualifying vessels do not have restrictions on crew size while fishing for other species and landing no scallops.

2. Shucking and sorting machines

Shucking machines are prohibited on board scallop vessels which possess more than 400 pounds of scallop meats or 50 U.S. bushels of scallops, as are sorting machines for vessels which shuck scallops at sea.

3. 3½ inch minimum shell height

Unshucked scallops will be subject to the current 3½ inch minimum shell height standard. The current procedure allowing temporary adjustments to the shell height standard will not continue.

4. 400 pounds trip limit for non-qualifying vessels

Non-qualifying vessels may continue to fish for scallops or land them as a by-catch if they possess no more than 400 pounds of scallop meats or 50 U.S. bushels (2150.42 in^3) of scallops. These vessels will be prohibited from landing more than 400 pounds of scallop meats or 50 U.S. bushels within a period.

5. Dredge restrictions

Controls to enhance escapement of small scallops and by-catch will be made through the following provisions:

a. 3¼ inch minimum ring size in year one and two

All scallop dredges will be required to use at least 3¼" rings. This ring size will be required upon plan implementation.

b. 3½ inch minimum ring size after year three

At the beginning of year three of the fishing effort reduction schedule, all scallop dredges will be required to use 3½" rings. No rings under 3½" will be allowed onboard scallop dredge vessels after that time.

c. 30 feet limit on the total width of all dredges

A maximum 30 feet dredge width (for example, two 15 feet dredges) is required. Qualifying vessels may apply for an alternative permit that requires a single ten foot, six inch (10.5 feet) dredge and the applicant will receive a one-category increase in days at sea. This restriction will remain in place until the annual permit expires.

d. Prohibition on chafing gear, cookies, more than double linking, or other obstructing devices

Chafing gear, cookies, or any devices which obstruct the top of the dredge gear are prohibited on the top of any scallop dredge. Scallop dredges are required to have no more than double linking between rings.

e. 5½ inch minimum mesh twine top

A minimum mesh of 5½ inches is required for twine tops located on the top of dredge gear.

6. Trawl restrictions

Controls to enhance escapement of small scallops and by-catch will be made through the following provisions:

a. 5½ inch minimum mesh

All vessels which trawl north and east of Hudson Canyon are limited to a 5½" minimum mesh (throughout the top and bottom), with no chafing gear in the top of the net. Scallopers using trawls south and west of Hudson Canyon are required to use mesh no less than 5". All scallop trawlers will be limited to a 5½" minimum mesh after year two.

b. 144 feet trawl sweep limit

All scallopers using trawls are limited to a total 144 feet trawl sweep.

7. Data reporting

This amendment requires the establishment of a new data collection and monitoring

system to achieve the objectives of the management measures. Participation in the data collection program will be mandatory for all vessels landing scallops and all dealers buying and handling scallops from domestic vessels.

The system may require real-time data collection, and will combine current weigh-out, sea sampling, vessel permit, proposed (dealer, broker and processor) buyer permit and enforcement monitoring information. The Plan Development Team recommended some elements that should be included in a mandatory data collection system for scallops (Appendix IV), but the exact nature of future systems will be determined by the Regional Director.

To support the development of the database the following requirements will be implemented by the amendment:

Scallop fishery buyers must obtain a permit and will be liable for violations of the management measures where appropriate;

Fishermen and buyers (dealers, brokers, and processors) will be required to report data needed to monitor the scallop fishery; and

Fishermen and buyers will be responsible for the purchase of the necessary equipment (credit-card machines, transponders, etc.) to allow data collection.

A dual-reporting system involving both fishermen and dealers may be necessary to accurately record all scallop landings by both limited access and general permit vessels. The National Marine Fisheries Services will develop and implement the system in consultation with the Council and the Scallop Plan Development Team.

8. Effort monitoring

Full-time and part-time limited access scallop vessels will be tracked through a monitoring program for the days-at-sea or layover day measure. The mandatory and continuous use of transponders for full-time scallopers is required. Part-time and occasional vessels may choose to report their scalloping effort by using the transponders or by complying with another system to be determined by the Regional Director. The latter system may be a call-in program which would require vessel operators to notify the Regional Office of their departure from and return to port within a specified number of hours.

Transponders (VTS): The transponder system is an electronic, satellite positioning and communication system consisting of four elements: the shipboard transponder, a pair of satellites, a shore-based central computer, and a base station. Communications are transmitted between the vessel and the base station, or other vessels, through the central

computer and relayed by the satellites. The central computer is linked to the base stations by conventional land line. The base station can be any personal computer or a dedicated piece of hardware which is pre-programmed to perform specific functions such as location mapping. Position information is obtained when the transponder emits a signal which is received by the pair of satellites and then relayed to the shore-side computer. The computer calculates the position of the vessel based on the information sent by the satellites. The shore-side computer sends the position information to the base station which can plot the position on a map or transmit it back to the vessel. The enforcement of effort regulations will entail a periodic transmission of a vessel's position. Days at sea will accumulate when a vessel's position is outside of the port and the vessel has not reported to the Regional Director that it is not fishing for scallops. Days at sea will be determined by the cumulative hours at sea divided by 24.

The enforcement of the layover-day regulations will entail periodic transmission of a vessel's position, as well as a "declaration to fish" via transponder when a vessel embarks on or returns from a trip. Enforcement officials would be able to determine the status of a vessel through a base station that monitors the fleet. Similarly, the base station could alert enforcement officials if a particular vessel is not complying with the layover-day regulations.

Vessel notification system: For vessels in the occasional fleet category, the effort monitoring system would use electronically coded plastic cards or rely on a telephone call-in system. Both systems would rely on individual operator entry of vessel status. While the electronic card system systems would require manual entry of data by way of electronic card reader/dialer and the call in system would be automated, the costs of setting up and using both systems are expected to be significantly lower than the VTS option.

Under the electronic card option, each "occasional" permit holder would be issued one electronic card which would be encoded with the permit number and a personal identification number. The vessel operator (may be someone other than the vessel permit holder but who would be permitted under the proposals in Amendment #4) would register by way of the card reader/dialer when he was leaving port to go fishing. The operator would be required to have the card in possession while at sea and would report in to the system upon returning from the trip. The host computer at NMFS would register the duration of the trip and could identify (to the minute) when that vessel would be authorized to go out again under the terms of the layover day system.

The card reader/dialer is essentially the same equipment used by retailers to verify and authorize credit-card transactions. The units facilitate two-way communications and moderate data entry by way of a microprocessor, keypad and two-line LCD display. Each unit would be registered to a verified telephone number (land-line only, no cellular or mobile system). Units could be located at fish houses, fuel docks, coop docks, or any other

point convenient to fishermen. In fact, individual fishermen could conceivably have these machines at home for maximum convenience.

The process would work as follows. A fisherman would "swipe" the card through the machine. The reader would call the host computer to indicate that a transaction will be taking place. The machine would "hang up" and the host computer would call that specific machine back at the telephone number for which that machine is registered. The host computer would prompt the operator to indicate whether he was starting or ending a trip.

Other types of transactions could also take place within the capabilities of the individual units. For example, a unit at a fish buyer's location could be used under the "mandatory data reporting" system to enter landings and other data. Vessels pursuing fisheries other than groundfish, or vessels declaring the required blocks of time out of groundfish could do so with the same device. The potential exists once the systems are fully operational and functioning in real time that the lead time for declaring out of groundfishing could be reduced to a minimum. Other applications could be incorporated into the system as they are developed.

A call-in system would include the same notification requirements. Enforcement agents, however, would have to rely entirely on timely notification of a vessel's fishing status. Under the electronic card system, the additional requirement that scallop vessel operator must possess the card while fishing would make it more difficult to circumvent the days at sea restrictions.

9. Penalties

Penalties for violations of scalloping regulations may include permit sanctions and penalties up to the $100,000 maximum now allowed under the Magnuson Act. They include:

Permit sanctions ranging from one month to permanent revocation for certain serious violations;

Maximum penalty for the first violation of certain measures; and

Severe penalties for non-reporting or misreporting into the monitoring and enforcement database system.

F. Framework mechanism

1. Regulatory measures and Council intent

The Council proposes to implement the frameworks for management adjustments and the procedures contained in the regulations for Amendment #4 of the Pacific Coast Groundfish Fishery (50 CFR part 663, App.III.B) to allow future adjustments to measures implemented by and considered within Amendment #4 for Atlantic Sea Scallops. Future adjustments for resource conservation, social, or economic reasons will be recommended under the framework procedures if they are consistent with the criteria, procedures, goals, and objectives set forth in the Atlantic Sea Scallop FMP.

As in the Pacific Coast Groundfish FMP, three types of frameworks will be used to classify proposed changes to the management measures. Each framework provides guidance on the necessary amount of public review and comment and, therefore, dictates the procedure that the Council will follow in making the recommendations. If the NMFS Regional Director does not concur with any part of the Council's recommendations, the Council will be notified in writing of the reasons for rejection. The Secretary is expected to waive for good cause proposed rules and comments by publishing a final rule in the *Federal Register*. These guidelines are not intended to derogate from the Secretary's authority to take emergency action under section 305(e) of the Magnuson Act.

Three frameworks are defined in 50 CFR 663 to be used under various conditions which are explained in section V.F.3. The first framework establishes a procedure for classifying and adjusting "routine" management measures. The "points of concern" framework allows the Council to develop management measures that respond to resource conservation issues. The "socio-economic" framework allows the Council to develop management measures in response to social, economic, and ecological issues that affect the fishing community. Associated with each framework is a set of criteria that form the basis for Council recommendations and with which Council recommendations will be consistent.

The framework procedures in 50 CFR 663 establishes a general process for developing and implementing management measures that normally will occur over the span of at least two Council meetings, with an exception that provides for more timely Council consideration under certain specific conditions. These conditions are explained in more detail in 50 CFR 663, App.III.B. As in the Pacific Groundfish FMP, Amendment #4 contemplates that the Secretary will publish management measures recommended by the Council in the *Federal Register* as either "notices" or "regulations." Generally, management measures of broad applicability and permanent effectiveness are intended to be published as "regulations." Those measures that are more narrow in their applicability and which are meant to be temporary or require frequent adjustment are intended to be published as "notices." At this time, the Council intends the management measures listed below to be implemented by the former process (i.e. "regulations") rather than the latter.

2. General procedures and criteria

Adjustments to the management measures contained in Amendment #4 are anticipated at specific intervals within the seven year rebuilding schedule (section V.C.3). This intention does not preclude making adjustments at other appropriate intervals. The proposed days at sea schedule for full-time, part-time, and occasional vessels is, however, intended to remain in place for three years until the fishing mortality and effort relationship, and the impacts of the new gear restrictions can be more fully understood. Four procedures for adjusting management measures are available under 50 CFR 663, 1) automatic actions, 2) "notice" actions, 3) abbreviated rulemaking, and 4) full rulemaking through regulatory amendment. Each action has specific criteria and requires different amounts of opportunity for comment. Satisfaction of the legal requirements of other applicable law (e.g. the Administrative Procedure Act, Regulatory Flexibility Act, Executive Order 12291) for actions taken under this framework requires analysis and public comment before measures can be implemented by the Secretary.

All management measures proposed or considered by Amendment #4 may be established, adjusted, or removed using any of the four procedures. Even though certain measures are proposed to be developed within a specific framework process, the Council may through majority vote require development through a more stringent process should public testimony or conditions warrant. Although some adjustments will have impacts that fall within those analyzed during the development of Amendment #4, e.g. adjustments to days at sea, the Council proposes to classify all adjustments under the abbreviated or full rulemaking processes because of their controversial nature or because of the potential for differential impacts. Other potential actions that may be taken via abbreviated and full rulemaking cover a wide range of potential impacts, analyses of biological, social, and economic impacts will be performed and evaluated when a particular change is proposed. During future adjustments, however, the Council may consider further adjustments to a measure to be routine and non-controversial and may reduce their framework requirements and process to "Notice" actions or automatic adjustments. The four basic categories of management actions are as follows:

a. Automatic actions

Actions proposed under this procedure may be initiated by the Regional Director without prior public notice, opportunity to comment, or through a Council meeting. These actions are non-discretionary and the impacts must have been previously analyzed and taken into account. The Secretary will publish a single "notice" to make the action effective.

b. "Notice" actions

These actions are intended to have temporary effects and are expected to need frequent adjustment. They may be recommended at a single Council meeting, although it is preferable that the Council provide as much advance information to the public as possible.

Management actions in this category are either non-discretionary or the scope of probable impacts must have been previously analyzed and taken into account. At least one Council meeting is required and the Secretary will publish a single "notice" making the action effective.

c. Abbreviated rulemaking

This framework process would be used to adjust most of the management measures contained within Amendment #4. Actions proposed through this procedure will be considered to be "routine", or will have a permanent effect and which are discretionary, for which the impacts have not been previously assessed. The Council will develop and analyze the proposed actions over the span of at least two Council meetings, and provide advanced public notice of the availability of both the proposals and the analyses. Opportunity to provide written and oral comments will be provided throughout the process before submitting the recommendations to the Regional Director. It is very likely that the Council will convene and consider the advice of the PDT and Industry Advisory committee during this process.

If the Regional Director approves the Council's recommendations, the Secretary is expected to waive for good cause the requirement for a proposed rule and opportunity for public comment in the *Federal Register*. The Secretary, in so doing, will publish a "final rule" to remain in effect until amended. Submission of recommendations does not preclude the Secretary from deciding to provide additional opportunity for prior notice and comment in the *Federal Register*, but it contemplates that the Council process will adequately satisfy that requirement.

d. Full rulemaking or regulatory amendment

Future actions proposed through this procedure are considered to be highly controversial or makes direct changes in resource allocation. Several managment measures which would directly result in a reallocation of the scallop resource or which were not preferred are included as framework measures for future consideration. The impacts of these actions generally fall outside the scope of impacts previously analyzed, but new analyses will be performed and considered during the framework process. The Council will follow the process established for abbreviated rulemaking, but additional deliberations and opportunity for comment is expected. The Secretary will published a proposed rule with an appropriate period for public comment, followed by publication of a final rule.

3. Frameworks and proposed management measures

a. Routine framework

"Routine" management measures are those that the Council determines are likely to be adjusted on an annual or more frequent basis. Future recommendations of measures to be considered as "routine" will be made through the full or abbreviated rulemaking process. Measures determined to be of this type will address the issue at hand and may require further adjustment to achieve its purpose with accuracy. "Routine" measures may be modified through a single meeting and "notice" procedure only if 1) the modification is proposed for the same purpose as the original measure, and 2) the impacts of the modification are within the scope of the impacts analyzed when the measure was originally classified as "routine." The analysis of impacts need not be repeated when the measure is subsequently modified, if they do not differ substantially from those contained in the original analysis. The Council may also recommend removing a "routine" classification.

Eight measures are currently proposed as being "routine" because future adjustments will be for the same purpose as established by Amendment #4 and the scope of probable impacts have been analyzed (sections V.F and VII). Although the recommended adjustments to the first four measures (i-iv) might be temporary and the scope of probable impacts have been analyzed, the proposed recommendations are expected to cause concern and may cause indirect changes in resource allocation. Once the application deadline for limited access permits has passed, days at sea adjustments due to vessel attrition are expected to be a routine matter. A notice action process for this adjustment (i) is therefore proposed. Adjustments to the remaining seven management measures will be considered through abbreviated rulemaking unless they are not significant or controversial.

i. Days at sea adjustments due to vessel attrition

Vessel operators may tender their permit for an entire permit year in order to fish in other fisheries without being subject to scallop regulations. Since the number of scallop vessels that have active limited access permits will be known in advance, the Council may consider changes to the days at sea allocations and to allow the remaining vessels to fish at higher levels without undermining the rebuilding schedule. This adjustment would be temporary, and would extend for a maximum of one year. Alternatively, sea scallop permits may be purchased to permanently tender its days at sea allocation. Under this provision, the permit's effort allocation will be redistributed among the remaining limited access vessels. The impacts associated with this temporary adjustment are similar to those analyzed for adjustments to the effort reduction schedule and are analyzed and considered in Amendment #4.

During October through December, vessels will declare their intent to scallop during the following year. In January, therefore, the Regional Director will be able to report the number of tenders, buy-backs, and non-declared vessels within each days at sea group. The Council may reallocate the days at sea to vessels based on the allowable total days at sea and the number of limited access vessels for that year.

ii. Days at sea adjustments due to changes in fishing mortality

Adjustments to days at sea caused by observed changes in fishing mortality are anticipated after the pause years (section V.C.3). If days at sea have been reduced to appropriate levels according to the rebuilding schedule but F remains higher than anticipated, then the days at sea schedule will be adjusted downward. This outcome can be expected if, for example, fishermen significantly improve their effective fishing effort per day at sea. On the other hand, F could be lower than anticipated if vessel attrition is greater than expected or fishermen don't increase fishing effort to match the limits on days at sea (section VII.A.2.b). The days at sea schedule might be relaxed in this case. After the first re-evaluation, the Council expects enough available information to enable annual adjustments to adhere to the established fishing mortality schedule. The scope of probable impacts due to mis-specification of the effort mortality relationship have been analyzed and considered in sections V.F.2 and VII.F).

iii. Shell height

One of the potential, unanticipated effects of Amendment #4 might be a switch to shell stocking during periods of high scallop abundance. During these times, the shucking capacity of a nine or five man crew is limited by the size of the scallops. This management measure is intended as an age at entry control to delay harvest, improve spawning stock biomass, and improve yield per recruit. If vessels switch to shell stocking, it might undermine the objectives of the FMP. The proposed 3½ inch shell height may not be effective in limiting a switch to shell stocking and an avoidance of the crew size limitation. Under these circumstances, the Council might consider changes to the shell height regulation so that it matches the age at entry objectives projected by limits on crew size. Since the anticipated impacts of Amendment #4 do not include an increase in shell stocking, adjustments to this measure to maintain current practices are within the scope of analyzed impacts.

iv. Effort monitoring

Effort monitoring through vessel tracking systems (section V.E.9) or call-in programs (section V.G.7) are included in Amendment #4, depending on the group categories. Adjustments to this management measure may be necessary for technical reasons. For example, if one segment of the fleet is given the option to use a call-in program but only ten percent of that group uses that method, the Council might consider a requirement that all limited access vessels use vessel tracking systems. Since a variety of effort monitoring systems are analyzed by Amendment #4, changes to the effort monitoring system have already been analyzed and considered.

v. Permitting rules

Certain technical changes to the permitting procedures may be necessary to allow efficient administration, to improve enforcement through permit sanctions, and to identify participants for mandatory data collection.

vi. Data reporting

Certain new data elements might be desired within the mandatory data reporting system that were not provided during initial implementation of Amendment #4. Required reporting of these new elements or a differing method of reporting, e.g. using vessel tracking systems to report logbook data, might be considered to provide adequate information to adjust other management measures.

vii. Offloading windows

Offloading windows will be discontinued because the previous meat count regulation will not need enforcement. During development of Amendment #4, enforcement agencies preferred retaining the offloading windows for enforcement of the new regulations. If they prove to be unenforceable during periods outside the previous offloading windows, then the Council would consider reinstatement of this measure. Because of its long history of usage in the fishery, the associated impacts are considered within the non-preferred alternatives (section V.G).

viii. Other monitoring and enforcement measures

Some technical changes having negligible impact may be necessary to allow better monitoring and enforcement. Requirements to make logbooks or catch available to authorized agents or to allow unhampered and randomized sea sampling might be considered under the "routine" framework.

b. Points of concern framework

The Council's scallop PDT will monitor the fishery and the management program. Following the guidelines in 50 CFR 663 for this framework, the Council would make recommendations to the Regional Director for changes in the management program. In identifying resource conservation issues and "points of concern", the Council will consider any change in the biological characteristics of the species or stock complex and whether recruitment is substantially below replacement level. The biological considerations will include updated information on growth, natural mortality, size at maturity, reproductive behavior, larval distribution and settlement, and the relationship between spawning stock and recruitment. Information concerning stock structure, fishing mortality, recruitment to

the fishery, and stock abundance will also be considered.

Five measures are proposed for the points of concern framework because of their biological implications and the impact on resource conservation. The scope of impacts from adjustments to these measures have not been analyzed and may have socio-economic implications. Changes to the measures, however, are intended to respond to resource conservation issues rather than revising the management program to gain socio-economic benefits alone. In general, the scope of impacts arising from adjustments to these measures have not been analyzed. If adjustments are recommended, new analyses will be prepared and evaluated. Adjustments to the first four measures will be considered to be permanent, but depending on the severity of the changes may not be highly controversial. It is not likely that they would cause direct changes in allocation. Adjustments to these four measures would be made through abbreviated rulemaking. The fifth measure would cause a direct change in resource allocation and, therefore, recommendations would be made through full rulemaking.

i. Ring or mesh size

Ring size in dredges and mesh size in trawls are intended as a primary control on the size of harvested scallops. These measures have a significant bearing on spawning stock biomass and on the threshold fishing mortality rate established by the overfishing definition. Research into the effectiveness of ring size and mesh size in limiting the harvest of small scallops is recommended. Once this information is available, the Council might recommend changes to these restrictions through the appropriate framework process.

ii. Other gear restrictions

Amendment #4 includes a prohibition on chafing gear, cookies, more than double linking, or other obstructing devices within the scallop dredge. Although this measure restricts most gear modifications that would allow the capture of small scallops, the points of concern framework would allow the Council to respond to unanticipated changes in scallop gear.

iii. Vessel based mechanical processing

Sorting and shucking machines are prohibited from certain vessels to limit on-board processing capacity that would undermine the intent and effectiveness of the crew size limits. The Council may consider other measures that restrict mechanical processing on-board scallop vessels if they undermine the effectiveness of the management measures.

iv. Overfishing definition

The overfishing definition for Atlantic sea scallops (section F.1) provides a more detailed

description of the basis and procedures for changing the overfishing definition. The recommendations to change the 5% MSP level would be made through abbreviated rulemaking.

v. General category trip limit

The general category trip limit of 400 pounds of scallop meats or 50 U.S. bushels of shell stock was based on current resource conditions and harvesting practices. As resource conditions change, more fishermen may be able to make profitable trips and increase effort within the general category moratorium exemption. If these changes are substantial, the effort reduction imposed on limited access vessels would become less effective in controlling fishing mortality. If this occurs, the Council may consider and recommend changes to the general category trip limit instead of further limiting effort by limited access vessels. Since this action would cause direct changes in resource allocation, adjustments to this measure would be recommended through full rulemaking.

c. Socio-economic framework

Non-biological issues may arise that cause the Council to recommend management actions to address social or economic issues. These recommendations would be made through the framework procedures to achieve the stated social or economic objectives of the FMP. In making these recommendations, the Council will follow the guidelines established by the socio-economic framework in 50 CFR 663. The Council will prepare a report containing the rationale for the recommended actions by convening the Industry Advisory committee or the PDT to develop or review the report.

The socio-economic framework is appropriate for twelve measures contained within Amendment #4. All adjustments would be considered permanent and would be made primarily to improve the socio-economic benefits of the management plan. The first two measures (i-ii) would be considered in conjunction with a tradeoff in days at sea or another management measure and therefore would have differential impacts. These adjustments would be recommended through abbreviated rulemaking. Adjustments to the remaining ten measures (iii-xii) would either cause direct changes in resource allocations or constitute considerable changes to the management plan and be controversial. Recommendations for changing the latter ten measures would be made through full rulemaking.

i. Dredge width or trawl sweep limits

Adjustments to these limits would benefit certain segments of the fleet, protect localized resource areas from non-prevalent fishing activities, or allow more time at sea by reducing effective fishing power. More research would be needed to define the latter relationship, but the Council may consider adjustments if such information were available.

ii. Crew size

Crew size can be an effective limitation on the harvest of small scallops. Nonetheless, the Council may consider adjustments to crew size to address safety issues or to mitigate increases in effective fishing power through processing innovations.

iii. Mesh size area restrictions

Because there are different mesh regulations for finfish trawling throughout the management unit for sea scallops, vessels trawling for scallops south and west of Hudson Canyon will be permitted to use 5 inch mesh for the first two years following implementation. Modifications to the boundary may be necessary to coordinate mesh regulations with other fisheries if the five inch mesh is found to limit the catch of small scallops to levels controlled by restrictions on dredges. Alternatively, an extension to the exception due to prevailing resource conditions may be required if few large sea scallops would be available to the larger mesh at year three.

iv. Allocation of days fishing instead of days at sea

Monitoring and limiting days at sea is expected to cause differential impacts on vessels from various ports. It also is expected to induce vessels to relocate closer to productive fishing grounds whenever possible. These unintended effects do not contribute to the intent of Amendment #4, but monitoring and limiting the number of fishing days is not technically possible. If future technological developments allow monitoring of days fished, the Council might recommend changes to the effort monitoring system to reduce the unintended effects.

v. Moratorium rules

If fishing effort and fishing mortality declines faster than anticipated and stock conditions improve, the Council may consider the alternative of relaxing the moratorium rules and allowing new entrants instead of allowing more days at sea to a small group of participants. This outcome might be expected if substantial numbers of qualifiers exit from the fishery or to provide for fishery participation by future generations.

vi. Group definitions

Some unanticipated inequities in the current form of effort allocation may become apparent following implementation. Either the threshold participation levels or the number of groups could be reconsidered to reduce the social impact and improve economic efficiency through a framework adjustment.

vii. Limited access trip limits

Trip limits for limited access vessels were considered as a non-preferred alternative during the development of Amendment #4. When changes to effort restrictions are considered, trip limits may be recommended to improve economic performance, e.g. evenly distribute seasonal landings, rather than force further restrictions through reduced days at sea allotments.

viii. Layover day requirements

This non-preferred management measure could have similar effects as explained above and might be considered as an additional measure to the individual days at sea restrictions.

ix. Closed seasons

Closed seasons may be considered to reduce the catch of newly recruited, small scallops to improve yield per recruit. This measure may also be considered to control an increase in effective fishing power created by seasonal shifts in fishing effort which would translate into higher fishing mortality. The former rationale would justify a temporary closure, while the latter might require a more permanent regulation.

x. Closed areas

Closed areas would be considered to protect localized concentrations of small scallops from pre-mature exploitation.

xi. Fishery quotas

This management measure would impose a total annual (or another period) quota on the fishery. Fishing would be prohibited once the quota was reached. This management measure was generally opposed early during the development of Amendment #4. Nonetheless, future resource conditions, better predictability of future biomass from the survey data, and changes in the fishery economics might justify using quotas in lieu of adjustments to other management measures to achieve the plan's objectives.

xii. Vessel quotas

The rationale for this management measure is similar to fishery quotas, except it does not retain a competitive incentive to overcapitalize the fishery. Vessel quotas would have similar characteristics to individual vessel days at sea allocations, but would not require other constraints on effective fishing power.

G. Evaluation of the Preferred Alternative

1. Implications of the overfishing definition and the need to reduce fishing mortality

An evaluation of the effort reduction alternatives (including the preferred) should be considered with the guidelines in 50 CFR 602. These guidelines require the Council to define overfishing, determine whether the species is in an overfished condition, and if it is, develop a strategy for ending the overfished condition.

The overfishing definition was developed by the PDT and was based on historic recruitment patterns and the life history characteristics of Atlantic sea scallops compared to other species.

Overfishing is defined as a fishing mortality rate that, if continued, results in a spawning stock biomass of five percent of the maximum spawning potential. The corresponding target fishing mortality (F) will be calculated as a level that will result in a 5% MSP under equilibrium conditions.

The fishing mortality rate that estimates the current level of fishing on all stocks is defined as the average mortality on fully recruited age classes weighted by the relative number of scallops within each stock. When age-structured assessments are not available for individual stocks, current fishing mortality estimates from other sources, such as changes in fishing effort or survey based data will be used.

The MSP threshold may be adjusted as additional biological evidence becomes available. To make changes to the MSP level, the updated targets will be reviewed by the Scallop Plan Development Team, and approved by the Scallop Committee and Council.

The PDT anticipated three reasons that changes in the overfishing definition would be necessary:

1. The current estimate of an appropriate MSP threshold (5%) is considered to be a provisional biological reference point that will be adjusted as more biological data become available. In particular, updated information on spawner-recruitment relationships, SSB/R ratios, and age-specific fecundity will provide better insight into the MSP threshold. Better information concerning growth, natural mortality, size at maturity, reproductive behavior, larval distribution and settlement, and the relationship between spawning stock and recruitment is expected to become available. This additional information, if accepted by the Plan Development Team, will be used to modify the proportional MSP targets within the overfishing definition.

2. This definition addresses the risk of recruitment overfishing and is not intended to be a substitute for other plan measures to stabilize yield (F_{msy}), increase yield per recruit (F_{max} = 0.18), conserve the resource ($F_{0.1}$ = 0.10), or to achieve other economic benefits.

3. The minimum size harvested by the fishery plays a critical role in the conversion of a %MSP value to a target fishing mortality rate. At this %MSP level and anticipated ranges in minimum size, the target F is very sensitive to the behavior of the fishery. Once the new management regime is implemented, new partial recruitment data (i.e. age at recruitment to the fishery) will allow more accurate determinations of target F.

It is the intent of the Council that changes to the reference point ($F_{5\%}$) in the overfishing definition will be made through regulatory amendment at the recommendation by the Council.

This definition in terms of percent maximum spawning potential as the biological reference point, 5% MSP as the threshold, and anticipated changes in the overfishing definition are explained in Appendix V. For the Georges Bank/Mid-Atlantic stocks of Atlantic sea scallops, the proposed (preliminary) overfishing threshold could allow up to 60% ($F_{5\%}$ = 0.97) of scallops older than age three to be harvested every year.

A level of 5% MSP falls within a range which is associated with several biological reference points, such as the SSB/R (spawning stock biomass to recruitment) ratio that passes through the recruitment maximum and for several different time periods. The 5% MSP level is considered to be a base level, from which the Council may strive to achieve biologic, economic or other objectives.

Preliminary analysis indicates that fishing mortality rates have been above the threshold level since 1987 and the stock is currently overfished. Effort has risen substantially since then (Figure 1). Current fishing mortality is approximately 40% over the overfishing definition threshold. For comparison with other useful biological reference points, F_{max} equals 0.22 and 0.23 in the Delmarva and the South Channel areas respectively.

Rebuilding schedule: This amendment is designed to eliminate the overfished condition seven years after implementation. The seven year mortality reduction schedule and the associated effort reduction program are the result of a compromise between the recovery rate and minimizing the economic and social disruption to the fishery. Recent stock levels have been high, and although recent reports indicate rapidly declining adult biomass quick changes in fishing mortality may not be necessary to preserve the long-term reproductive potential. Scallops exhibit notable variability in recruitment and therefore, short-term

changes in stock abundance would be more influenced by future recruitment than by changes in fishing mortality.

While developing an effort reduction strategy, the Council considered many different schedules before the final strategy was adopted. Five year plans with two-step, three-step, linear, and front loaded reductions were examined (Appendix VII). Yield and revenue streams were considered during the process (Appendix VIII). Although some of the above strategies predicted quick recovery times in terms of yield and catch per unit effort, the Council believed the quicker reduction schedules would result in draconian changes in yield and in the fishing industry. There was also considerable uncertainty regarding the direct control of fishing mortality through days at sea restrictions. Therefore, the Council adopted a seven year strategy with two pause years to assess the goal and the progress being made toward that goal.

After the close of comments on the draft amendment and DSEIS, the Council considered the public testimony and made several changes which affected the proposed fishing mortality schedule. As a result of public comments regarding the impact of the proposed allocation system and the voluntary data system upon which it is based, the Council voted to allow days at sea allocations based on less stringent requirements. At the same time, it required the group allocations of days at sea for the first three years to remain unchanged from the amounts published prior to public hearings. These actions resulted in the expected number of full-time scallop vessels to rise from 160 to 190 and caused the projected fishing mortality rates to rise over previous estimates.

In fact under the preferred alternative, fishing mortality is projected to rise above current levels. The revised allocation system would grant full-time status to vessels that a) averaged full-time fishing activity, greater than 150 days at sea, between 1985 and 1990, b) fished at a full-time level during 1990 regardless of their prior history, c) averaged full-time fishing activity when their initial fishing activity was pro-rated for a partial year, and d) changed ownership immediately following the control date and fished at a full-time level in 1990, and 1991 or 1992. These actions grant the highest allocation of days at sea to those vessels that fished full-time in 1990 and to those vessels that fished full-time in 1985-1990, but not in 1990 alone. Therefore, some vessels that did not fish full-time in the baseline year (1990) are able to increase their fishing effort. Some of this potential is evaluated in section VII.F.1.a.

The impact on future fishing mortality, days at sea, yield, and net economic benefits due to a), b), and c) above were included in the analyses. Item d) cannot be analyzed until conclusion of the appeals process since the Council has no data to show the date a vessel began in the scallop fishery. Fishing mortality is expected to rise in the first year because of the opportunity for some vessels to increase their fishing above 1990 levels. It may also increase because of compensatory changes in fishing behavior, modifications to gear and

deployment to maximize the catch with the new gear restrictions, and the possible improved efficiency of dredges with larger rings to catch large scallops. If scallop vessels that fished below the group allocation do not fish at the group allocation or if they do not compensate for the gear restrictions, then fishing mortality may be less than expected. Although these responses cannot be assessed, it will probably take more than one year for fishermen to fully respond to the changes in management. In subsequent years, the additional restrictions on days at sea and gear is expected to overcome the marginal increases in efficiency that may be caused by the above responses.

2. Beneficial and adverse impacts on commercial fishery

Formal economic cost/benefit analyses and discussions are presented under Sections VII.F.3. This section will discuss the relative environmental costs and benefits of each of the management measures in the preferred alternative.

a. Moratorium

Since the primary management measure is an allocation of days at sea to individual vessels, allowing new entrants to the scallop fleet would allow total effort to rise despite the effort reductions on individual vessels. To compensate for new entrants, the proposed effort reductions would need to be greater than if the fleet maintains its current size.

The permit moratorium will cap the number of vessels that fish for scallops while the effort control program is in place. In fact, the number of active scallop vessels rose steadily through 1989. Although total fishing effort has continued to increase (Figure 1), the control date has been effective in capping the number of participants in the fishery (Table 3).

Without a limit on the number of participants, there would be no way to effectively allocate future days at sea. An effort reduction target of ten percent of days at sea for individual vessels, for example, could be negated by a ten percent increase in the number of vessels. No net reduction in fishing effort would, therefore, be achieved.

Further, to allow all vessels with a history in the scallop fishery to participate would require management measures which would make scallop fishing uneconomic for most of the fleet (full-time scallop dredges). For instance, by allowing all vessels which meet the 400 pound per trip criterion to qualify, the effort reduction program would begin with 570 vessels. By following the moratorium rules defined below for the Atlantic sea scallop fishery, that number is reduced to 403 vessels with a stake in the fishery. Five hundred and seventy vessels in the fishery, given that most were occasional operators, would require much lower mean days at sea per vessel under the effort reduction schedules.

The second objective addresses the concern of many fishermen who are being forced to radically change their traditional fishing behavior under the effort reduction program. These fishermen have pointed out that if they must take short-term reductions in catch through the reduced effort allocation, they should be the ones to first benefit from the rebuilding program. Without a permit moratorium, vessels that have not been forced to make the sacrifices under the effort reduction program could enter the fishery as soon as stocks begin to rebuild.

b. Permits

Permits for the various entities in the scallop fishery are needed for a number of reasons. In order to make sure that the only vessels directing fishing effort on scallops (over 400 pounds per trip) are qualifiers under the moratorium, all vessels in the fishery need to be permitted. These vessel permits make enforcement easier at sea. The U.S. Coast Guard can quickly ascertain whether a fishing vessel should be fishing for scallops. In addition, a vessel permit makes tracking the participants possible when vessels are sold or transferred.

The primary benefit of an operator's permit is to provide for accountability. Administratively, the permit program would be enhanced if it were coupled with the proposed U.S. Coast Guard (USCG) operator's license. Upon application for the permit, individuals would be notified that if the permit holder violates the regulations and is issued a "Notice of Permit Sanction", he/she will forfeit the right to work in any capacity on any commercial vessel fishing for federally regulated species during the period of sanction. There are approximately 403 vessels subject to the vessel moratorium. The total number of operators requiring this permit would be equal to or slightly more than this number of vessels.

Industry has expressed the view that permit sanctions are more effective than monetary penalties in deterring violations. Sanctions are no longer a "cost of doing business" when supply can be interrupted or employees laid off. The permit sanction would be viewed as a severe penalty to be applied only in the case of serious violations.

The primary purpose of a dealer permit is to improve enforcement of the regulations through dealer accountability. A second purpose is to improve the administration of the FMP by identifying the participants in the fishery and principle business locations. Once identified, the Council and NMFS can provide notices and other information to processors/dealers on changing regulations that might have an impact on how they conduct their business. Regulations that concern dealers include recording time landed (for days at sea) and amount of landings, minimum shell sizes, trip limits or possession limits (by-catch), and offloading windows that might interrupt the supply of product in the short term. Dealer identification also provides a secondary avenue for information dissemination to fishing vessels.

While the costs of administrating these permits is high (Section V.F.4.a), they are certainly less than the costs of trying to collect comprehensive data and enforcing limited entry without a mechanism to determine participation in the fishery.

c. Effort reduction

Effort control is necessary to reduce fishing mortality without excessive changes to gear, minimum sizes, etc. that would affect scallop age at entry into the fishery. A days at sea approach is preferred because it needs no annual adjustment because of fluctuations in recruitment. That is, proportional reductions in fishing effort will reduce fishing mortality whether recruitment is high, medium, or low. It also allows maximum flexibility by allowing fishermen to schedule scallop trips and fish for other species when not fishing for scallops.

The preferred alternative classifies historic participants into three groups according to their

former participation in the fishery. The rationale behind this particular form of allocation is that all participants will be treated equally, while not pulling full-time operators down to part-time status and minimizing reliance on the voluntary, weighout database. Appendix II contains a detailed discussion of the various alternatives that were considered.

The Council initially proposed to have a days at sea reduction program with up to twenty-two vessel classes based on GRT and historic participation. The Council's Plan Development Team recommended these groups and the method to be used to classify vessels because it felt that the data for the scallop fishery was robust for this purpose, the twenty-two classes would not drastically penalize or reward individual vessel operators, and that fewer appeals would occur. Fewer appeals might occur because successful appeals based on some missing data would not cause a large change to a vessel's days at sea allocation.

The Council's Industry Advisory Committee recommended fewer vessel groups, based on the lack of comprehensive landings data and a desire to establish equal participation under the amendment. They recommended two groups, a full-time class with histories of 150 or more annual days at sea and a part-time class with less than 150 days at sea. Further discussions revealed a large number of seasonal operators with much lower days at sea histories. These vessels would be rewarded by granting them as much as 97 days at sea in the first year of the program. As a compromise, the Council adopted a three class system of occasional, part-time, and full-time vessels.

The data base that will be used to classify vessels in the scallop fleet is the NMFS weighout data base. Although it is a voluntary data collection program, approximately 80-90% of the sea scallop landings are recorded through the system. Many vessels, especially at large ports like New Bedford, MA and Hampton, VA, have all their trip's landings recorded in this file. The Council believes that with sufficient opportunity for appeal and realistic goals for utilizing the data to classify vessels, the weighout data can be used to allocate future days at sea limits to groups of vessels.

Two pause years are scheduled to allow the Council to examine the relationship between days at sea reductions and the change in fishing mortality. Adjustments to the days at sea reduction schedule will be made by the Council during years four and seven. These changes will be made upon recommendation by the Council to the Regional Director. These adjustments will be implemented by regulatory amendment.

It is very difficult to anticipate the potential for adjustments to the days at sea reduction schedule. Numerous changes to gear and fishing practices are contained in the amendment to counteract the effects of removal of the meat count standard. If enforcement is effective and compliance is high, greater effort reductions will not be necessary. The expected outcomes are illustrated in Table 2.

If however, the supplementary measures are not effective in capping fishing power, more days at sea reductions will be necessary. An example at the high end of likely outcomes is contained in Table 1. Depending on the nature of the problem, the expected yields and revenues are most likely within the range examined in Section V.G.3. If higher reductions in days at sea are necessary, more economic dislocation and more idle capital within the scallop fleet should be expected.

Expected Yield: The actual yield resulting from the effort reduction program is expected to depend on the level of recruitment (the age-class of small scallops just starting to be caught commercially) during a particular year. Because recent recruitment has been good to exceptional (Wigley et al. 1991), nearly all of the projections (Section VII.F.2.a) have yields below current levels. Only 5% of the yield projections result in values near or exceeding current landings.

The mean yields projected for status quo fishing mortality (F) ranged from 16.5 million pounds if current F is 2.25 (Figure 28) to 18.3 million pounds if current F is 1.50 (Figure 29). While this is considerably below the long-term potential catch estimated by NMFS (1991a), it is slightly below the mean annual landings of 19.9 million pounds since 1960. The mean projected yields for a reduction of F to 0.97 (the overfishing definition) with 3½ inch rings are almost 22 million pounds in both cases.

Most importantly, the projected yields for the preferred alternative beyond year seven are 18 to 38 percent higher than No Action alternative yields if current F is 2.25. For the case when current F is 1.50 (Figure 30), the projected yields are 12 to 21 percent above the No Action alternative. In general, the expected change in yields are very robust to differences in future recruitment. Interestingly, the change in yield relative to the No Action alternative is marginally higher (18% vs. 17%, 16%, and 14% for average, high and very high recruitment during 2005-2008) under conditions of low recruitment. Therefore, the preferred alternative (and similar effort reduction alternatives) will act as a better buffer against exceptionally low recruitment than other management programs that rely on only an age at entry control.

Year three of the effort reduction schedule is expected to have the lowest yields, projected to be 8 to 18 percent lower than the No Action alternative (Figure 30). This decline occurs despite a respite in effort reduction, because of expected yield losses when 3½ rings are implemented. This decline in yield, however, is much less than the 24 to 29 percent loss in yield expected if 3 inch rings (non-preferred) are allowed in years one and two (Figure 31).

Years one, four, and five are approximately neutral in terms of yield compared to the No Action alternative. Years two and three of the proposed schedule are expected to result in smaller yields than No Action alternative. In no case for the preferred alternative is yield

expected to be less than 19% below that expected for the No Action alternative.

Population structure: In terms of standing stock biomass, spawning biomass (%MSP), age distribution, and catch per unit effort, the preferred alternative (and the other effort reduction alternatives) is expected to be quite different than the No Action alternative. Standing stock biomass will decline under any alternative if future recruitment falls to average levels. Nonetheless, the standing stock would be higher throughout the seven years (including year one) if effort were reduced.

Fishing at current levels would allow the spawning stock to be about 2% on average of unfished levels. Reducing fishing mortality to the overfishing definition threshold is expected to result in an average spawning stock of 5% MSP by year ten. Moreover, there will be predominately more age groups contributing to catches than at present. A significant number of eight year old scallops will exist after F is reduced to 0.97.

Catch per unit effort will increase substantially compared to the No Action alternative. These increases are expected to be 80 to 200 percent depending on the current fishing mortality rate (Figure 32). Since the preferred alternative would decrease the time vessels spend at sea fishing for scallops, their annual operations costs will be lower. Therefore, the catch per unit cost is expected to be higher, making many vessels which remain in the fleet after year four to be more profitable.

By-catch: Effort reduction is also expected to have a beneficial effect on the by-catch of finfish and associated species. The reduced fishing effort on scallops will provide similar benefits (reduced fishing and discard mortality) to other by-catch species. On the other hand, some redirection of fishing effort by non-qualifying vessels and vessels not using their scallop days at sea can be expected. The amount of impact on other fisheries will depend on the outcome of appeals, the type of management in place for other species, and the method used to restrict fishing effort. The preferred alternative allows maximum flexibility in vessel operators allocating their time to fish for scallops and other species. The amount of fishing on other species by qualified vessels who are not fishing for scallops is unknown.

d. Supplemental measures

Most scallop dredge vessels currently shuck scallop meats while at sea. Crew members execute this process by hand. The amount and size of scallops selected for shucking is usually a function of the crew size and the catch rates (Kirkley and DuPaul 1991b). The crew size restriction is intended to cap the fishing power of these vessels at sea by limiting their processing (shucking) capacity. It also may cause fishermen to discard more small scallops if catch rates are high, as predicted for years beyond five of the proposed management program.

The nine man crew limit is expected to cause a limited amount of unemployment within the commercial fishing industry. Although there are some problems with this information in the NMFS permit files, 90% of operators indicate that they carry a crew of nine or less (Figure 4). Some fishermen have indicated that they carry more than nine crew members, sometimes by 'hot bunking'. Sutenin et al. (1992) found that the number of crew on vessels was determined by the boats capacity to accommodate crew and on the expected catch rates.

Effort monitoring: The preferred method for monitoring effort for full-time and part-time vessels would employ transponders, or vessel tracking systems. These systems will make continuous and frequent reports on a vessel's position to a central facility. From this information, NMFS will be able to tell whether a vessel is "at sea" or "in port". Vessels that cross a pre-defined boundary are considered "at sea" and fishing for scallops unless they otherwise report their intentions to the Regional Director. From this data, NMFS will calculate the accumulated days at sea and reports may be made to the U.S. Coast Guard when a vessel exhausts its days and is at sea fishing.

Fishermen testified at public hearings that monitoring days at sea causes different impacts on vessels whose home ports are more distant from the fishing grounds. While there will be a premium on time at sea, the Council believes that this form of effort monitoring will not place fishermen at a competitive disadvantage that did not already exist before the effort reduction program. A vessel's days at sea allocation will be based on a history which includes the extra transit time required for vessels in distant ports. These vessels may continue to fish from their ports and will not experience a greater reduction of days fished than closer vessels. These distant vessels can, however, land scallops at closer ports to optimize their days at sea. In so doing, these vessels may be impacted less by the management measures than other vessels. Because there may be some unavoidable inequities inherent in monitoring days at sea, the preferred alternative includes a framework provision to allow monitoring of days fished when it is made possible through technological improvements. The social and economic impacts of changing the monitoring system will be evaluated when the necessary technology becomes available.

Under the proposed effort monitoring program, vessels will be required to purchase or lease the shipboard equipment. Mobile units currently cost between $1,200 and $7,800 to purchase, or about $150 per month to lease (60 month lease). There is a $35 per month connection fee, and a $35 per month minimum message fee. The minimum message fee covers monitoring requirements of an hourly transmission of the vessel's position. Additional messages sent at the discretion of the vessel operator would cost $0.50 each plus $0.004 per character. There are additional charges for extended warranty coverage (about $495 annually) and optional computer connections via modem, for example.

This method of calculating position is highly accurate, and, unlike "Satnav" systems, can provide instantaneous position information upon request, or at any pre-programmed interval. Although the transponder system carries a considerable price tag (first year cost of $1.2 to $5.8 million for 403 qualifying vessels), they can offer added benefits to U.S. Coast Guard search and rescue. The costs of administering and enforcing days at sea limits or layover days would be considerable without such a system (Section V.F.4 discusses these costs).

The applications of this system are numerous and extend beyond the enforcement use which is proposed for the scallop fleet. For enforcement purposes, the system will be used to monitor a vessel's compliance with the proposed layover day provision. Vessels which are connected to this system, however, can take advantage of a number of other uses of the communication and positioning capabilities. For example, they could communicate with a shore-side base to obtain spot market prices, to send or receive business and personal messages, or to obtain alternative weather forecasts. They could also communicate privately with other vessels beyond the range of marine VHF radio capability. Distress signals could include the nature of the emergency and an instantaneous position. Communications between vessels, or between a vessel and shore, it should be noted, are not two-way conversations (in voice mode) but are messages transmitted in computer-coded language.

A number of scallop boat owners have testified that they have already installed transponders for their own use. The Canadian Department of Fisheries and Oceans has embarked on a pilot project to use the system for enforcement of their fisheries regulations and to gather fisheries statistics. If successful, a transponder system might be required aboard all Canadian fishing vessels.

The remaining supplemental measures are in the present regulations on scallops. They remain in the preferred alternative because they have been found to be useful and acceptable to many fishermen.

e. Gear restrictions

A number of gear restrictions are included in the preferred alternative. Trawl sweep and dredge width limits will cap a potential for increasing fishing power associated with a day at sea. The proposed dredge and trawl width limits approximate the largest gear currently in use (DuPaul and Kirkley, pers. comm.). It is not anticipated that these restrictions will cause many fishermen to purchase new gear after implementation of the amendment.

Other gear restrictions are intended to mitigate the removal of the meat count regulation. These measures will allow greater escapement of small scallops and associated by-catch. No data is available to determine the impacts of these measures. Although some gear experiments have been conducted with some of the proposed restrictions (DuPaul and Kirkley 1992), no studies are available for the entire suite of measures.

Very few vessels use rings greater than 3 inches or trawl gear with meshes as large as 5½ inches. Nearly all fishermen are using some form of chafing gear, cookies, multiple links, and smaller mesh twine tops. These gear restrictions will require the entire fleet to modify or replace portions of their fishing gear. This may not cause undue hardship if fishermen are notified of the gear restrictions a few months in advance of implementation. Several fisherman have testified that it is common to replace rings and certain other elements of dredges several times per year.

f. Data collection

The Council and NMFS have been roundly criticized for their somewhat incomplete voluntary data collection system. Since more accurate fishing mortality and stock size estimates will be necessary to adequately evaluate the amendment's progress in years three and six, the Council recommends a mandatory data collection program. Even though it will probably be more costly than the current weighout data system, other forms of data collection and enforcement to ensure accurate data will likely cost more.

The data collection system will provide the information required to adjust the management measures, such as trip limits (potentially in-season), days-at-sea or layover days, as needed (at least during the pause years). The new database will improve fisheries statistics for all scallop fishermen and dealers. Strict access limits will be maintained so that only properly authorized agents/employees of the government may obtain the information.

g. Framework adjustments to management measures

The proposed regulatory measures in Amendment #4 are designed to limit participation, reduce fishing effort to sustainable levels, and to control scallop age at entry. These objectives will be achieved through the following management measures: a moratorium on

the number of directed scallop vessels, restrictions on the days at sea allocated to limited access vessels, limits on crew size, a prohibition on shucking and sorting machines, a restriction on scallop shell height for shell stock, a trip limit for general category vessels, restrictions on ring size and gear characteristics, provisions for data reporting and effort monitoring.

The Council recommends applying the frameworks and their procedures provided in 50 CFR 663 to the Atlantic Sea Scallop FMP. Like the Pacific Coast Groundfish FMP, the measures in Amendment #4 will need adjustments to accurately reach its objectives. Achieving these adjustments through the four frameworks will reduce administrative costs and increase responsiveness and flexibility. The administrative cost reductions are unknown. They will depend on the frequency of adjustments and the framework processes employed to submit recommendations. A framework adjustment mechanism will, however, reduce costs by diminishing the need to publish a proposed rule or submit a full FMP amendment. Because the public is substantially involved in the Council process, the Council believes that publishing a proposed rule for proposed adjustments and allowing further public comment would be duplicative.

The abbreviated process for recommending and implementing changes to the management measures will be possible because of the high degree of public involvement in the Council process. The North Pacific and the New England Fishery Management Councils' review of management proposals is substantially similar. The New England Council has seventeen voting members and four non-voting members. Voting members are the state fishery directors of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut, the Northeast Regional Director of the NMFS, and eleven individuals who are knowledgeable about the New England fisheries and who are appointed by the Secretary of Commerce from lists submitted by the governors of the constituent states. Non-voting members are the Regional Director of the U.S. Fish and Wildlife Service, the Commander of the Coast Guard District, the Executive Director of the Atlantic States Marine Fisheries Commission, and a representative from the U.S. Department of State.

The Council also utilizes several committees to seek expert advice and provide review of proposed measures. These committees are convened several times during the development of a new management proposal. The Council maintains a standing committee of industry advisors who represent the following interests: nineteen fishermen, two processors, and three industry association representatives. The fishermen represent diverse groups from both large and small ports from within and from outside the Council's constituent states. Four industry advisors are from Maine, thirteen from Massachusetts (which has the largest scallop port), one from Connecticut, four from New Jersey, and two from North Carolina. The Scallop Oversight Committee, composed of Council members, also includes representation from the Mid-Atlantic Council (a fisherman / processor from Virginia), and from the South Atlantic Council (a state director from North Carolina). In addition, the

Council relies on a Plan Development Team for scallops which provides technical review and analysis during the development of a plan, amendment, or proposed management measures. This PDT is composed of scientists from academia, the NMFS Northeast Regional Office, the NMFS Northeast Fisheries Science Center, and staff members from three east coast Councils. The PDT has also included representatives from the U.S. Coast Guard when the discussions involved enforcement issues.

The Council considers scallop management issues at a series of Scallop Oversight Committee meetings and at regularly scheduled Council meetings. All meetings of the Council and its committees are open to the public. Council meeting notices, including a list of issues to be considered, are published in the *Federal Register*. Notices, agendas, and newsletters are distributed through a mailing list of approximately 1,350 names of individuals and organizations that includes vessel owners, processors, fishermen, fishermen's organizations, and fisheries service industries such as fishery consultants, joint venture companies and port managers. These persons may also receive draft and final FMPs, amendments and proposed regulations. The Council also maintains an interested parties list of approximately 300 names of individuals and organizations that receive notices, agendas, and relevant information on scallop committee meetings.

Interested persons regularly attend Council meetings and obtain descriptions and analyses of the proposals being considered. Portions of the Council and Scallop Oversight committee meetings are specifically set aside to receive public comment. The public is invited and regularly avails itself of the opportunity to make both oral and written comments, and to discuss any management issue with Council members and Council advisors.

3. Beneficial and adverse impacts on the recreational fishery

A minor recreational fishery for scallops exists. Most is conducted by SCUBA diving in state waters, primarily ME. Therefore, most of Amendment #4's management measures will not apply to recreational fishermen (unless they hold a federal permit to scallop). If recreational fishing for scallops did occur in the EEZ, the only provision that might apply is the 3½ inch shell height standard.

4. Administrative, enforcement, and information costs

a. Administrative costs

The issuance of annual vessel permits for sea scallops will not change under Amendment #4. Vessels that do not qualify for limited access permits will still be allowed to apply for a general category scallop permit. New costs arising from the preferred alternative are associated with issuing days at sea allocation permits to qualifying vessels, buyers (dealers, brokers and processors), vessel operators, and captains.

As of November 16, 1992, 2,550 vessels held valid sea scallop permits. Assuming that the same number of vessels fishing in 1992 will fish in 1994, at least 2,550 operator/captain permits will be required. Under the moratorium, the Council expects 403 qualifying vessels will receive a days at sea allocation. The number of dealers that buy and sell sea scallops is perhaps the most difficult to estimate. There are approximately 30 major dealers (MA, ME, NJ, VA and RI) that are known to purchase sea scallops. For purposes of estimating costs, however, the maximum number of potential dealers is estimated to be 150.
Costs will also occur when administering permits when vessels are replaced or upgraded. Vessels must be certified as to whether they are being replaced by a vessel with the same total effective fishing power. The estimated total cost of permits, calculated under Paper Work Reduction Act requirements in Section XI, is estimated to be $77,921.

Appeals: The moratorium and effort allocation program provides an appeal process for vessel operators who feel their days at sea allocation is in error and for vessels that do not, but should, qualify. The initial appeal must be in writing and the applicant will have the right to an oral hearing. Conservatively, 435 vessels might appeal under the preferred alternative, 272 non-qualifiers (half of non-qualifying vessels that landed scallops in 1990), plus a maximum of 263 vessels in the part-time and occasional vessel categories. The estimated total cost of administering the appeals, calculated under Paper Work Reduction Act requirements in Section XI, is $69,950.

Effort monitoring: Additional administrative costs are associated with monitoring individual vessels' days at sea. NMFS is currently exploring features and costs of various types of systems. Effort control is one of the provisions under development for Amendment #5 of the Multispecies FMP. A total cost for a transponder receiver and a computer link of $8,000 is expected. Maintenance will probably cost $3,000 per annum. Management of the system is estimated to cost about 0.5 man-years and $13,399 (GS-9). Including maintenance and software costs and amortizing the installation costs over five years, the annual cost of administering this system is estimated to be $20,249 (Table 44). The estimated annual cost to NMFS of administering an electronic card or a call-in system for an estimated 100 occasional vessels is $10,622 (Table 25).

b. Enforcement costs

Most of the proposed measures can be enforced dockside. Enforcement of the current meat count standard has been expensive. Dockside enforcement devoted to the sea scallop fishery by NMFS cost approximately $224,198 in 1991. This total does not include equipment, vehicles, court time, etc. Cost savings are expected because of the proposed changes from the current meat count enforcement system to an effort control program. A number of provisions in the preferred alternative will minimize additional burden on enforcement personnel. The proposed days at sea system eliminates the need for

enforcement personnel to enter fish holds and examine many bags of scallops to determine compliance with the meat count standard.

Fishermen onboard vessels choosing to shell stock can keep unshucked scallops in addition to shucked, bagged scallops. Costs to enforce shell stocking limits should not change because the minimum shell height will remain at 3½" inches (89mm).

There will be an additional cost to enforce the 400 pounds of scallop meats trip limit for general category permits. Because many of the current permit holders do not have recorded data in the NMFS weighout files, it is not known how many land small volumes of scallops. Therefore, the costs associated with trip limit enforcement is unknown. Nonetheless, the enforcement of the 400 pound trip limit can be conducted dock-side as well as at sea (400 pound possession limit for non-qualifying vessels).

Costs will also occur to enforce the maximum crew size of nine, the 3¼" and 3½" ring size change, and the minimum 5½" mesh size for trawls. These proposed changes will require some at-sea enforcement. The current at-sea meat count enforcement has been expensive. At-sea enforcement for the Coast Guard is estimated to require two contacts per vessel per year with an average of four contacts per enforcement vessel per day. The Council expects that mostly patrol vessels ($6,828 per day) will be used although medium endurance cutters ($26,664 per day) might be required during rough weather.

Under the preferred alternative, vessels will reduce their effort over a seven year period. Coast Guard at-sea enforcement will require much lower mean days at sea per vessel under this effort reduction program. No aircraft surveillance will be necessary. Cost savings are expected because of monitoring by vessel transponder systems.

c. Information (data collection) costs

The Council proposes to require mandatory reporting of landings and effort data. One possible system could combine the current commercial fisheries data collection system with vessel log books to gather information from all vessels which harvest sea scallops, as well as those dealers which buy directly from them.

From experience with the surf clam and ocean quahog fisheries, it is clear that accurate records of each vessel are crucial to the process of monitoring the activity in the fishery. The fact that the information was provided directly from the fishermen improved fishermen's confidence that their efforts were fairly represented. Cost estimates for this new reporting system were generated based on similar programs operated by NMFS.

Number of reports: As of November 16, 1992, 2,550 vessels held valid sea scallop permits. Under the preferred alternative 403 vessels will qualify for a limited access permit. A fig-

ure of 2,550 permits is considered to be high, since many owners obtain permits to retain the option to fish, even though they may not have actually fished for scallops recently. NMFS weighout data indicate that, in 1991, 299 vessels landed sea scallops with scallop dredges (Section VI.D.1).

Permitting of buyers (dealers, brokers and processors) is required. The number which buy and sell sea scallops is perhaps the most difficult to estimate. There are approximately 30 major dealers (MA, ME, NJ, VA and RI) that purchase sea scallops. For the purposes of this analysis, 150 weekly dealer reports is used. Table 22 summarizes the expected number of reports required annually.

Costs: Government costs for administration will have four major components: printing costs for report forms, mailing costs for postage paid return, labor costs of processing, and capital costs for computer equipment.
Printing costs were estimated using the costs of record books which the Northeast Regional Office (NMFS) recently purchased for the surf clam and ocean quahog fisheries. Each book contains 50 weekly report forms (and postpaid mailers) and costs $8.00 each ($8,000 for an order of 1,000 books). Assuming that costs will be similar for sea scallop reporting books, first year printing costs are expected to be (2,550 + 150) x ($8.00 per book) or $21,600.

Annual mailing costs include mailing out record books plus the regular postage for each report submitted. The initial mailing will cost NMFS ($2.90 per book) x (2,550 + 150 books) or $7,830. Respondent mailing costs are estimated to be $8,874 for vessel owners and $2,306 for dealers.

Labor costs will equal the salary of a GS-5 government employee ($17,686) plus a 29.5% overhead (benefits and taxes) or $22,974 per person per year. A federal employee works approximately 230 days per year (excluding holidays, leave, and weekends). The labor cost rate for processing is therefore $22,974 / (230 days x 8 hours per day) or $12.50 per hour. At an estimated 5 minutes to process a report, the amount of time required to process the logbook information will equal (5 minutes per report) x (12 reports per year) x (2550 vessels reporting) x ($12.50 per hour) or $31,875.

Providing computer equipment for a processing staff will cost approximately $3,000 per person for a computer and the necessary accessories. Amortized over five years and including an estimate of $250 for annual equipment and software maintenance costs, annual equipment costs are estimated to be $850 per employee and (319 / 230) x 850 or $1,179 for the program.

Weekly reports from dealers are expected to take longer to process than vessel reports, because they include landings from more than one vessel. Using a figure of 15 minutes for each, dealer reports will require (15 minutes) x (52 reports per year) x (150 dealers) x (12.50

/hour) or $24,375. Annual dealer reports are estimated to require 1/2-hour of processing time. Labor costs for the annual report are estimated to be (150 dealers x 0.5 hours x $12.50/hour) or about $938. Total estimated labor costs for processing dealer reports are therefore $25,313. Equipment costs are based on 1.1 man years of processing time and $850 per man year or $935.

The total annual costs to NMFS for data collection are estimated to be $87,797 (Table 23). The estimated annual cost to the industry is $30,375 for dealer reports and $123,624 for vessel logbooks (Section XI, Paperwork Reduction Act).

Effort monitoring

VTS: The preferred alternative requires timely data collection to monitor effort for qualifying vessels. NMFS will obtain the central equipment to receive and monitor effort data. These costs are included under Section V.G.4.a. Vessel owners will be required to purchase and maintain compatible equipment from approved vendors.

One hundred thirteen full-time and 100 part-time vessels participating in the limited access scallop fishery will be required to carry a VTS device. Because as many as 50 vessels may be added to these fleet categories via the appeals process, the estimated total number of vessels required to carry these devices is 263. The estimated number of vessels in the occasional category following appeals might be as high as 100. As mentioned earlier, small vessels that possess and land less than 400 pounds of scallops will not be included in the days at sea monitoring system.

Annualized costs of the system are best represented by the cost of leasing a system that is known to fully meet NMFS specifications. The lease cost of such a system including hookup, hourly location monitoring and a maintenance agreement is approximately $3,135 per year for a five year lease (Table 24). The exact price will depend on interest rates and the credit standing of the lessee. Vessel owners possibly could reduce this cost by purchasing the systems or by using a less expensive systems that still meets NMFS specifications. To avoid under-estimating, however, the lease price will be used as the basis for determining costs. Annual costs to the industry of a system that will meet all of NMFS requirements is estimated to be $844,754.

Magnetic-strip card system (electronic card): The electronic card system would be utilized to monitor days at sea by vessel in the occasional fleet category. After renewal of a valid scallop permit, vessel owners in the occasional fleet category would be issued a card containing a coded magnetic strip that is unique to the vessel. The card could be read by card readers placed in either common locations (auctions, dealers, unloading docks, etc.) or at the individual's home if a convenient location is not readily available. The readers would be purchased by individuals or associations and range in price from between $265 to

over $500, determined by the quantity purchased. Card readers would be connected to a computer at NMFS through a telephone line which would record and verify the information encoded on the magnetic strip. The computer could initiate a call back to the reader to verify the actual location of the call.

The costs that NMFS would incur to development and administer the system would be for the purchase of communications equipment to receive the transmissions from the readers, programming support necessary to set up the system, storage, and the phone charges. It is estimated that up to 100 vessels making up to thirty trips per year could be subject to this requirement. Initial installation costs are summarized in Table 25.

NMFS's choice between a call-in or an electronic card system will be determined by what it chooses to monitor certain the groundfish vessels under Amendment #5 to the Northeast Multispecies FMP. Based on monitoring requirements for the scallop fishery as compared to monitoring requirements for groundfish, approximately 20% of the installation costs ($7,161) of the system would be attributed to the scallop requirements. Amortized over five years the annual system cost attributable to scallop monitoring would be about $1,432. Total annualized system development and recurring costs are estimated to be $10,622 (Table 25). The costs to NMFS of administering a call-in system is not expected to differ significantly from the cost of administering the electronic card system, although the cost to the fishing industry will be higher for the electronic card system because of the need to purchase card readers and cards. Estimated costs to the industry are $2,250 under a call-in system and $17,650 under an electronic card system (Section XI, Paperwork Reduction Act).

5. Impacts on consumers

a. Prices

Little information is available to directly assess the effect of the preferred alternative on consumer prices, i.e. retail prices. Several important changes in data availability have occurred in the last decade. The specification in the FMP included three market levels; ex-vessel, wholesale, and retail. Since 1981, retail prices (Baltimore) and wholesale prices (Boston) for scallops have been discontinued, thus those market levels can no longer be specified. Also since 1981, king crab prices (Chicago) have been discontinued. These prices were used as a substitute good in the FMP specification.

The economic analysis (section VII.F.3) was performed with ex-vessel price inputs to compare the two effort reduction alternatives with No Action. If retail prices are determined by a fixed markup over ex-vessel prices, the expected changes in consumer prices will follow suit. Of course, the results also depend on import prices. Although imported scallops vary in quality and price according to the country of origin, they are close substitutes for domestic sea scallops. This influence of import prices on ex-vessel prices is taken into account within the price model (section VII.F.3.a). If import prices stay constant, then ex-vessel and, therefore, retail prices are expected to increase during 1994-1997 compared to No Action because of decreased supply. After the scallop yield per recruit increases prices are expected to decline as domestic landings increase relative to No Action. Therefore, consumers will benefit from the increased abundance of scallops. Finally, the sensitivity analysis (section VI.F.3.f) indicates that consumer benefits will be positive even if import prices rise as much as five percent per year over the fifteen year period that was examined.

b. Product quality

Section VI.D.2.a describes the current at-sea processing of sea scallops. The current management plan, based on an average meat count, creates incentives for scallopers to mix and soak scallops at-sea. The Food and Drug Administration (FDA) discourages soaking on vessels. The agency considers scallop meats to be adulterated "if any water has been added, either directly or in the form of melted ice" (FDA 1989). According to the FDA, scallops normally contain 75-79 percent water. Their labelling standards require scallops having higher water content to be identified as such. Scallop meats having a water content exceeding 84 percent cannot be marketed (M. Benjamin, pers. comm.).

Management-related incentives to soak and mix scallops will be eliminated by the preferred alternative. Mixing scallops to achieve a semi-uniform distribution of sizes between bags of scallops will probably cease. There are other reasons, however, that cause scallopers to soak scallop meats at-sea. Soaking potentially increases product weight. If

scallop dealers do not compensate by offering different prices for unsoaked scallops, it can increase ex-vessel revenue. Soaking in iced sea water also enhances the chilling process and may improve quality.

Product quality is affected by trip length. Current trip lengths range from 12 to 20 or more days and are often constrained by factors external to the management program. The preferred alternative would remove the necessity to search for large scallops, but would increase the importance of fishing time compared to time travelling to and from port. The net effect of these two management-related factors is expected to be minimal. Trip length induced changes in product quality are not likely to significant.

6. Income redistribution

The proposed effort reduction program will restrict time at sea for each vessel. Some vessels may replace their lost fishing time for scallops with effort directed at other species (Section VII.A.2.b). Others will be able to reduce their variable costs by tieing-up during inactive periods. To the extent that the latter outcome occurs, there will be a redistribution of income within the industry.

Those vessels that fish less under Amendment #4 will decrease their supply costs for fuel, ice, food, etc. Their engines and gear will experience less use and will not need as much repair and replacement. By tieing-up for extended periods, fishermen can also reduce insurance costs by obtaining temporary 'port insurance'. On the other hand, because the scallop vessels will be in port more often, additional dock-space may be necessary.

Because crew size and time at sea are limiting factors under the preferred alternative, vessel operators might be more likely to land shell stock rather than shucked product. If this occurs, more processing employment may compensate for job loss in the harvesting sector.

In summary, vessel owners and captains will derive more income from scalloping because of declining variable costs related to a vessel's time at sea and because of increasing catch rates per day at sea. The gross annual stock for a vessel is projected to fall in line with changes in total yield, lower than the No Action alternative for the first three years and then subsequently higher than the No Action alternative. The net present value of yield to the fishery is positive (Section VII.F.3). Income is projected to shift from suppliers to fishermen and processors.

7. Marine mammals and endangered species

A number of protected species inhabit the management unit addressed in Amendment #4. Eleven are classified as endangered or threatened under the Endangered Species Act of 1973; the remainder are protected under the Marine Mammal Protection Act of 1972. Protected species utilize marine habitats for feeding, reproduction, nursing and migration.

Some species occupy the area year round while others use the region only seasonally or move intermittently inshore and offshore.

a. Listed and Threatened Species Likely to Occur in the Area Covered by the Amendment

Right whale (Eubalaena glacialis): With a population of 350 animals, this species is the rarest of the world's great whales. It inhabits the Cape Cod area from December to June and the lower Bay of Fundy from July to November. It migrates along the entire continental shelf to Florida from November to June.

Humpback whale (Megaptera novaeangliae): Humpbacks are found along the southern edge of the Gulf of Maine, Georges Bank and off southern New England from April to December. Concentrations of animals feed during the early spring months in the Great South Channel area of Georges Bank.

Fin whale (Balaenoptera physalus): The most commonly sighted large whale in the management area, it inhabits all continental shelf waters in all seasons.

Sperm whale (Physeter macrocephalus): Sperm whales are distributed along the shelf edge in all seasons, but in summer and fall can range inshore of the 1000 meter contour.

Blue whale (Balaenoptera musculus): Only occasionally seen in New England, the blue whale is usually found in open seas and in colder subarctic waters.

Sei whale (Balaenoptera borealis): Considered uncommon, sei whales are found along the eastern and southern edges of Georges Bank.

Kemp's ridley (Lepidochelys kempi): Although their offshore distribution has not been determined, ridleys are most often found in bays and coastal waters from Cape Cod to Cape Hatteras from summer through fall.

Leatherback turtle (Dermochelys coriacea): In the Northeast, they are found in open water throughout the summer. The southern migration occurs in near-shore waters from August to November.

Green sea turtle (Chelonia mydas): Generally an inhabitant of the Gulf of Mexico and southeast regions, green turtles are only occasionally seen in near-shore waters from MA to VA between July and November.

Loggerhead turtle (Caretta caretta): The most common turtle in the management area, loggerheads range from Cape Cod to Cape Hatteras from spring through fall.

b. Species Proposed for Listing

Harbor porpoise (Phocoena phocoena): The smallest of the cetaceans found in the Northeast, these animals occur in the Gulf of Maine year round and east and southeast of Cape Cod in spring and summer. The southern limits of their range may extend south to Cape Hatteras.

Bottlenose dolphin (Tursiops truncatus, coastal population only): The Mid-Atlantic coastal migratory stock ranges from FL to NJ in spring and fall.

c. Other Protected Species

Other species of marine mammals likely to occur in the sea scallop management unit include the minke whale (Balaenoptera acutorostrata) white-sided dolphin (Lagenorhynchus acutus), white-beaked dolphin (Lagenorhynchus albirostris), pilot whale (Globicephala melaena), Risso's dolphin (Grampus grisseus), common dolphin (Delphinis delphis), spotted dolphin (Stenella spp.), striped dolphin (Stenella coeruleoalba), killer whale (Orcinus orca), beluga whale (Delphinapterus leucas), Northern bottlenose whale (Hyperoodon ampullatus), goosebeaked whale (Ziphius cavirostris) and beaked whale (Mesoplodon spp.) (CeTAP 1982).

Fishery and Fishing Gear: A description of the fishery and both sea scallop dredge and trawl gear is provided in Section VI.D.1. Sections VI.D.1 also discusses the scallop fleet vessel characteristics and landings information.

Impacts: As indicated by information consolidated by the National Marine Fisheries Service through their Interim Exemption Program for Commercial Fisheries (NMFS 1991a), adverse impacts to protected cetacean species as a result of interactions in the sea scallop fishery are not likely to occur. Dredges are the most common gear type used to harvest sea scallops. Interactions with protected species are considered rare events because of the size and the manner in which the gear is deployed --- the dredge consists of a 15 feet frame and bag knit with steel rings 3 or 4 inches in diameter and interconnected with links. It is dragged along the substrate producing heavy sedimentation, noise and considerable disruption in the immediate vicinity of the tow. Tow times can vary between 15 and 75 minutes (DuPaul et al. 1988).

Sea scallop trawls, used primarily in the Mid-Atlantic region, are modified flounder trawls which tow 100-150 feet wide nets along the bottom for an average 40 to 45 minutes. Scallop trawl landings are about 2 million pounds (1991), or 5.3% of the total scallop landings by approximately 492 vessels. Despite the relatively short tow times and the gear being responsible for a small fraction of the total scallop effort, an expanded discussion is necessary relative to endangered and threatened marine turtles because of known takes in the summer flounder bottom trawl fishery prosecuted along the Mid-Atlantic coast.

Data collected by the University of RI's Cetacean and Turtle Assessment Program indicate that, by far, the most common species of turtle found in the waters between Georges Bank and Cape Hatteras waters is the loggerhead. Leatherback turtles are the next most abundant species followed by Kemp's ridleys and rarely green turtles.

Depth and surface water temperatures are thought to limit the activity of sea turtles. Aerial surveys of loggerheads at sea indicate they are most common in waters less than 50 m in depth (Shoop et al. 1981; Fritts et al. 1983), but can occur offshore. They enter embayments

in the Northeast when temperatures reach 20°C to feed on benthic invertebrates. There is evidence for a directed, southward movement once temperatures in northern coastal waters reach 14°C (Morreale et al. 1992).

Leatherback turtles are considered pelagic and feed primarily on jellyfish (Rebel 1974). They occur in low numbers between Cape Hatteras and Nova Scotia, primarily during the warmer seasons (CeTAP 1980). Sightings usually take place in the shallower regions of the continental shelf and at the surface where temperatures range from 13 to 27°C.

Adult and juvenile Kemp's ridley turtles feed primarily in shallow coastal waters on bottom-living crustaceans (Hildebrand 1982). They move northward from the Gulf of Mexico to coastal embayments when temperatures approach 20°C.

Although most nesting sites are located along the Atlantic coast of FL, juvenile green turtles occasionally have been sighted as far north as Long Island Sound, NY. The species is distributed in waters between the northern and southern 20°C isotherms (Hirth 1971).

Some overlap of the ranges of sea turtles and sea scallops may take place in fringe resource areas, but turtle distribution is constrained by water temperature and depth --- roughly 20°C and 50 to 60 m. While normal depth range for sea scallops is between 18 to 110 meters, they rarely survive temperatures above 20°C as described in Section VI.B.1. Optimum temperature for normal growth is 10°C.

An examination of NMFS weighout data suggests a potential overlap of turtle distribution and trawl fleet activity in areas 50-80 nm east of Delaware Bay and the Delmarva peninsula during May and June, and to a lesser degree throughout the summer months. A determination that interactions are unlikely, however, is based on the sea scallop distribution (Figure 3) which occurs in the greatest densities westward of areas where sea turtles are frequently sighted (CeTAP 1980). Although little information exists outside of the CeTAP data regarding sea turtle distribution in deeper waters, they are not likely to travel along the bottom because of aversion to low temperatures. Movements appear to be in shallower water where they forage during the spring and summer.

Turtles migrate into the Mid-Atlantic area in advance of warm surface water (over 20°C) in the spring and move southward out of the area in the fall, ahead of dropping water temperatures. The clear temperature preferences which are largely responsible for the apparent separation between optimum turtle and optimum sea scallop habitat, coupled with other characteristics of the fishery, indicate that adverse impacts to protected species, including endangered and threatened sea turtles, are unlikely to occur as a result of interactions with sea scallop trawls.

8. Conclusions

The preferred alternative represents the best set of measures to manage the sea scallop fishery. There is little evidence that scallop fishing has detrimental effects on habitat, marine mammals, or endangered species.

The seven year schedule represents the best compromise between a rapid response to the overfished condition and to maintaining a viable fishing industry. The effort reduction program which contains three groups is supported by the Industry Advisory Committee because it treats vessels within the large categories equally. The preferred days at sea program allows the greatest flexibility in fishermen's ability to schedule trips. On the other hand, certain shifts in fishing behavior are expected to maximize productive fishing time for each days at sea.

Short-term costs in terms of foregone revenue are significant in year three. Over the longer term, projected yields become positive relative to the No Action alternative. Net present value of benefits over fifteen years is positive.

Spawning stock biomass is expected to increase relative to the No Action alternative within the first year after implementation. Similarly, catch per unit effort increases after year one while the operational costs of fishing are expected to decline.

H. Alternatives Considered, But Rejected

1. Take no action

No action would result in continuation of the existing average meat count of 30 meats per pound and the 3-1/2 inch shell-height restriction. The Council has rejected this alternative because it does not address problems stemming from limitations of the meat count measure identified above, nor does it prevent overfishing.

2. Effort reduction with 22 vessel groups

The provisions of this alternative are the same as the preferred alternative, except vessels would be classified into more categories. The yield and economic projections for this alternative are the same as the preferred because interim fishing mortality targets and partial recruitment are the same.

Annual days-at-sea limits for qualifying scallop vessels (both dredges and other gears) would be allocated into 22 groups. The assignment of vessels to each group is based on historical performance of the vessel in 25 day groups and its tonnage class. Vessels less than 50 GRT (tonnage class 2) are classified separately from larger vessels (tonnage class 3 and 4). Many more of the smaller vessels would be classified into categories with fewer days at sea based on their participation in the directed scallop fishery between 1985 and

1990. The Council estimates that 26 vessels are in this class. Not all of the possible categories based on participation have vessels assigned to them. Hence, only 15 of the possible 22 cells are defined. Tables 4 and 5 illustrate the projected days at sea limits, if current F is 2.25 and 1.50, respectively.

Larger vessels are placed in groups that combine tonnage class 3 and 4 (greater than 50 GRT). Three hundred and seventy-seven vessels fall into these categories. All cells have vessels assigned to each participation category.

Limits on days at sea initially would be reduced from a baseline level reflecting the (dredge and other gear) fleet's performance in 1990 (Tables 4 and 5). For instance, when current F is assumed to be 1.50, a tonnage class 3 vessel in Group I (the 213-237 days at sea range) would start with 220 days. In subsequent years, the days at sea limit would be reduced by 11.0% (of 1990 levels), or 23 days, in the next year and by 9.5%, or 21 days in each of the last three change years. The 220 days start point is based on this group's average days per boat in 1990, which is at the high end of its average days per boat for 1985-90 (226 days). This group (3I) has only 54 vessels, out of 403 qualifiers, but accounted for 23.6% of the total days at sea.

The rationale behind this form of allocation is that it would allow the qualifying vessels to operate at a level closer to their most recent history. In other words, some vessels would not face substantial reductions in effort by fishing at the group mean. Likewise, vessels with histories at the low end of larger groups would not be rewarded by a higher limit on days at sea above their historic participation.

The Council initially proposed this allocation system as the preferred alternative. The Council's Plan Development Team recommended these groups (Appendix II) and the method to be used to classify vessels because it felt that the data for the scallop fishery was robust for this purpose, the 22 classes would not drastically penalize or reward individual vessel operators, and that fewer appeals would occur. The latter opinion was based on the size of the award for a successful appeal and the amount of data that might be missing in the data base.

The Council's Industry Advisory Committee recommended fewer vessel groups, based on the lack of comprehensive landings data and a desire to establish equal participation under the amendment. They recommended two groups, a full-time class with histories of 150 or more annual days at sea and a part-time class with less than 150 days at sea. Further discussions revealed a large number of seasonal operators with much lower days at sea histories. These vessels would be rewarded by granting them as much as 97 days at sea in the first year of the program, while others would face large, immediate reductions in their fishing practices. As a compromise, the Council adopted a three class system of occasional, part-time, and full-time vessels as the preferred alternative.

3. Effort reduction with adjustable layover days and fixed trip limits

Many provisions of this alternative are the same as in the preferred except that 1) fishing effort controls are composed of trip landing limits and minimum layover days between scallop trips instead of a days at sea restriction, and 2) vessel categories are somewhat larger (i.e., full-time and part-time without the occasional group).

Scallop vessels (both dredges and other gears) would be separated into two groups consisting of full-time and part-time participants. The assignment of vessels to each group is based on historical performance of the vessel during the period 1985-90. The rationale behind this classification system is that it treats all participants equally, while not imposing part-time status to full-time operators. All vessels within each of these two categories would receive the same trip limit/layover day restrictions based on the group's performance during 1988-1990. The reason for this shorter, more recent base period is because current resource conditions are more accurately reflected and thus industry behavior is better represented.

Full-time fleet: Vessels which averaged at least 150 days at sea annually for directed trips for scallops during the period 1985-1990 (selection of years is described in Appendix II). This allocation would be based on data recorded in the NMFS weighout files. Of the total days at sea allowed under the effort reduction program, 73.6% would be allocated to the full-time fleet.

Part-time fleet: Vessels which qualify under the moratorium but do not qualify as full-time vessels. The remaining 26.4% of total days at sea would be allocated to this category.

Table 6 shows projected days-at-sea schedules under the worst case scenario, that is the high-end base fishing mortality (2.25). Alternatively, Table 7 shows the days-at-sea schedules under the best case scenario, that is the low-end base fishing mortality (1.50). Total days at sea in the Atlantic sea scallop fishery would be reduced by 10.6% in the first two years and by 4.7% in years 4, 5, and 7, with two pauses in years 3 and 6, to reduce current (1990) F of 1.50 to the target F of 0.97 (Table 7).

The anticipated yield would depend on the level of recruitment (the age-class of small scallops just starting to be caught commercially) during a particular year, but is not expected to fall to less than 86% of what it would be under No Action (and should achieve levels at least 112% greater at equilibrium). Because the same intermediate levels of fishing mortality would be achieved, predicted yields and revenue are the same as expected when 3 inch rings are used in years one and two (Section V.G.5).

A trip limit and layover day requirement would restrict the fishery and control total days at sea by the Atlantic sea scallop fleet. After determination of the final number of qualifiers (i.e. after the annual declaration), specification of the first year's layover days can be established. Using an estimate of 421 qualifying vessels (dredges and trawls), the layover days would increase annually depending on the desired fishing mortality rate (Tables 6 and 7). Starting from 1 and 6 layover days for full-time and part-time fleets respectively in 1993 (or the first year of implementation), layover days are expected to increase to 7 days (full-time fleet) and 17 days (part-time) at the end of the rebuilding period (Table 7).

If the part-time fleet were limited to a six month season, then the layover days required become more like the full-time fleet's. However, the part-time fleet is actually composed of several sub-fleets which have different seasons. For instance, the Gulf of Maine scallop fleet fishes from November to March under state law, whereas many other part-time vessels start fishing from March to May and throughout the summer. Ten-thousand pounds per trip would help to constrain the total number of trips that vessels could make throughout each year, regardless of the level of recruitment. Because most of the effort reduction is derived from the layover day period, this alternative, like the preferred alternative, is not very sensitive to future recruitment and stock biomass.

This alternative is not preferred because trip limits and layover days are indirect ways to control days at sea. It also does not allow fishermen to fish seasonally without reducing their number of trips. An extension of the fishing season is a likely response to the increased layover period. Although the trip limit would help cap trip durations, vessel operators would tend to increase trip lengths to compensate for the fixed (as opposed to the layover being proportional to the trip length) layover.

4. Adjustable trip limit with fixed layover periods

Most provisions are the same as in the preferred alternative, except that 1) fishing effort controls are composed of trip landing limits and minimum layover days between scallop trips instead of a days at sea restriction, 2) vessel categories are somewhat larger (i.e., full-time and part-time with no occasional group), 3) the method used to determine the appropriate trip limit for a given stock size uses three years rather than a six-year average, and 4) target yields need to be set annually to determine what trip limits are needed to achieve the fishing mortality objective at the estimated stock size.

Qualifying scallop vessels would be classified the same way as in the adjustable layover period alternative, that is a full-time fleet with histories of annual participation over 150 days and a part-time fleet. The expected quota requires an allocation to the full and part-time fleets. It also needs to account for catches made within state waters and as a by-catch under the 400 pound limit. The target quota would be allocated 81.43% to the full-time fleet, and 13.02% to the part-time fleet, based on 1988-1989 weighout data. The remaining

5.55% would be distributed among the appropriate fleets based on the outcome of appeals, including the amount landed under the 400 pound by-catch provision or in state waters.

Target yield determination: A target yield would be adjusted annually to achieve the plan objectives and to reduce fishing mortality according to the same schedule as the preferred alternative. Any changes in stock size would require the target yield to be adjusted in order to achieve a target fishing mortality.

The target yield in each year might be either larger or smaller than the preceding year's yield depending on changes in recruitment, average harvestable sizes and the success of supplemental measures meant to control fishing power. Target yields would be set after taking into consideration the most recent landings data, data from the late summer scallop survey, and the scallop age distribution in the commercial landings.

As part of this alternative, the Council proposes establishing a target yield review panel (e.g. the NMFS / NEFSC SAW working group or the Plan Development Team) to determine the annual target yield in accordance with criteria established by the Council. Future yield estimation would be carried out much like the methods used to determine quotas. That is, the latest estimated stock size would be advanced to the year under consideration by assuming values for interim fishing mortality and recruitment.

Target yield and trip limit estimates are highly sensitive to recruitment. For instance, the target yields (in million pounds) under three recruitment scenarios, high, medium and low, are presented in Tables 8 (high current F, worst case) and 9 (low current F, best case).

These expected yields are shown for a range of recruitment levels (i.e., high, mean, or low quartiles). It is not possible to determine that recruitment would be high next year, medium the following year, etc. However, the expected yield is dependent on the actual levels of recruitment in previous years.

A trip limit and layover day requirement would restrict the fishery and control harvest to achieve target yield. After determining the number of qualifying vessels following appeals (i.e. after the annual declaration), the first year's trip limit would be established. Using an estimate of 421 qualifying vessels (dredges and trawls), the trip limit would vary annually depending on expected recruitment and the desired fishing mortality rate (Tables 8 and 9). Preliminary estimates range from a difference of 50% (most years for both full-time and part-time vessels) to smaller differences during certain years for full-time vessels (5,500 to 7,500 pounds per trip). Six layover days would be fixed throughout the mortality reduction schedule to constrain the total number of trips that vessels could make throughout each year.

For example, medium recruitment through 1994 is expected to generate a target yield of

19.4 million pounds and require a 6,500 pound trip limit (Table 9). A 1,500 pound trip limit would be required for the part-time fleet to ensure that it would not exceed its quota allocation. By 2002 a 6,500 pound per trip limit is expected to yield over 21 million pounds. This increase in total yield with no increase in the trip limit occurs because fishing mortality would be reduced by 40% and the expected gains in catch per unit effort make the average catch per trip rise. It is also important to note that the only case when a trip limit of 8,500 pounds could be maintained is if and only if recruitment remained at a high levels.

Bar coded bag tags: Data collection must be more rigorous than under the other alternatives to monitor the total yield and size of landed scallops. Improved data collection would allow for up-to-date analysis of relevant scientific information and the timely determination of the target yield. Enforcement and/or data collection would have to be improved to ensure fishermen don't exceed the trip limit.

Bar-code technology is already widely used and readily available. There is a precedent for using tagging as a method for monitoring landings, namely the cage tag now in use in the surf clam and ocean quahog fishery.

Once an annual permit is issued, each vessel would be sent a quantity of bar-coded bag tags which will bee encoded with the vessel number and individual bag number. For the enforcement of trip limits, the tags would also be encoded with a trip number. Only the number of tags equal to the trip limit divided by the standard bag weight would be issued. A bag tag would be used for each standard 40-pound bag or other standard package such as those used aboard freezer-trawlers.

Upon being filled, every bag of scallops would be tagged with a bar-coded tag. Trip number, permit number and other information could also be printed on the tag for visual inspection. Scallops bags would be required to be tagged from the time they are filled and closed until they are opened for sorting or washing at the dealer or processor. The integrity of the tag would be destroyed upon opening or removing it from the bag (such as if it were attached with a pop rivet or ratcheted snap).

Scallop dealers would be required to purchase laser readers. A provision would be made for dealers whose volume of scallops does not warrant purchasing the reader (about $2000-$2500). They would submit the tags on a daily basis to a central data entry point. Upon purchasing a load of scallops, the dealer would read the tags into the processor which would transmit the data to the central computer. After opening the bags, the dealer would return the tags to NMFS or possibly to the fisherman. Similarly, any tags which were not used on a particular trip would be returned by the vessel's captain to NMFS, ensuring complete accounting of all bag tags.

Dock-side enforcement of trip limits would be possible because a dealer would be required

to produce scallops for every tag registered to him. Conversely, he would be required to present tags for all unbagged scallops in his possession. The dealer could account for scallops purchased from foreign sources with the appropriate documentation. Vessel owners or captains would be accountable for all tags registered in the name of the vessel. Unused tags should be available on demand. The remaining tags would either have a record of landings entered onto the computer data base or have been returned unused to NMFS.

This system would allow for complete, accurate, and timely monitoring of scallop landings. Data would be entered automatically, minimizing labor costs, error margins and delays. Since the data would be instantaneously available, there could be continuous determination of the status of total landings relative to the target seasonal quota for each vessel fleet category. It would allow timely adjustments to trip limits as changes become warranted. Even though the number of tags that would be required is large, the cost of producing and distributing them is minimal. The laser readers, commonly used by retailers for inventory and sales accounting, cost more than $2,000, depending upon the system's options. In order to minimally monitor trip limits and landings, only the minimum equipment would be needed.

This alternative is not preferred because the trip limits/layover days are set to achieve an annual target yield, which would be largely based on the expected recruitment. If these measures are set assuming high recruitment and recruitment is actually average or low, for example, then trip limits/layover days would not be restrictive and would not reduce fishing mortality by the desired amount.

Although the trip limit would help cap trip durations, fishermen would probably respond to the fixed layover period by extending trip lengths until the trip limit is met. Lowering the trip limit to meet fishing mortality objectives would cause fishermen to make more frequent, but shorter trips as catch per unit effort rises. This would raise fishing costs by increasing the amount of transit time to and from the fishing grounds for each day fished. The model used to project trip limits under this alternative indicates that the average catch per trip becomes much closer to the regulated trip limit as effort decreases and stock biomass increases.

5. 3 inch rings in years 1 and 2

This alternative is a substitute for the use of 3¼ inch rings in the first two years of the fishing mortality reduction schedule. It replaces the more stringent gear requirement under any of the major alternatives (days at sea reductions, trip limits, and layover days). Because it would not reduce the catches of small scallops once the meat count standard was replaced, greater effort reductions would be needed. Trip limits would be lower than those calculated for 3¼ inch rings and layover days would be increased.

Tables 10 and 11 illustrate the projected days at sea limits for this measure under the preferred three vessel groups and the non-preferred 22 groups, respectively. Compared to the full-time category in the preferred alternative (Table 2), the total days at sea allotted to individual vessels in the group would decline from 205 days to 188 days in the first year. In year two, the group's days at sea limit would decline from 183 days to 166. Effort reductions in years four, five, and seven would result in lower days at sea than the preferred alternative, but the annual decreases wouldn't be as great (4.7% versus 7.5%). Yield projections (Figure 29) estimate that the yields under this alternative would be slightly higher than under the preferred alternative in years one and two. Conversely, yields would be substantially lower in year three, due to the expected declines in catch per unit effort when the gear changes from 3 inch rings to 3½ inch rings.

This alternative is not preferred because of the exacerbated drop in yield in year three and because projections indicate that it would not result in as rapid increases in spawning stock biomass compared to the expected No Action outcome. Furthermore, no decreases in by-catch of finfish and other benthic species would accrue due to increased escapement through larger dredge rings.

6. Supplemental meat count

This alternative would continue the current meat count standard as a measure to limit the catch of small scallops. It would supplement one of the above effort reduction or target yield strategies because, by itself, the meat count measure would not meet the plan's objectives under the overfishing definition. It would take the place of several supplementary measures in the preferred amendment that are expected to decrease the catch of small scallops. Specifically, this optional measure would replace increases in dredge ring size above 3 inches, the 5½ inch trawl mesh, the 5½ inch mesh twine top, and prohibitions on chafing gear, cookies, triple linking, and other obstructing devices.

This optional measure is not preferred because it continues a controversial management measure and no benefits would accrue regarding by-catch and discard mortality. In addition, projected yields for year three are substantially below those calculated when 3¼ inch rings were used. Although the meat count measure has worked in certain areas of

New England and the Mid-Atlantic region, numerous meat count violations have occurred and there is poor compliance in some areas. Because small scallops are mixed-in with larger scallops to maximize yield while adhering to the meat count, it is not expected that higher meat count regulations would be possible when coupled with an effort reduction strategy.

7. Twelve hour offloading windows

The present offloading windows enhanced enforcement because sub-legal scallops were frequently reported as being offloaded at night. Because the meat count standard is being replaced by other measures that do not depend on day-light hours enforcement, the offloading windows are no longer necessary. Although enforcement of some restrictions will be compromised, the continuance of offloading windows is seen as overly burdensome on industry.

8. Effort monitoring through sign-in/sign-out procedure

Two potential systems could be used instead of transponders to monitor effort (days at sea or layover periods), a time card and mag-strip identification system. However, since these systems involve manual recording and local verification, this program might be restricted to designated ports.

Time Cards: The time card proposal for monitoring layover day compliance relies on very simple technology, but more labor-intensive data entry. Under this proposal, vessel captains would use time cards, similar to those used on construction job sites, to register when a vessel enters or leaves port. The time card would be required onboard whenever the vessel is at sea. Exceptions would be made in the procedure to allow vessel movement for non-fishing purposes. Periodically, the punch cards would be submitted to a central data-entry location.

The advantages of this system are its relatively low cost and the ease of at-sea enforcement. Additionally, punch-card machines could be located at several sites, such as fuel or ice docks, dealers, association offices, fleet offices, even pier-head "booths", minimizing the burden of participating in this type of manual system.

There are also several disadvantages, namely, that there is no real-time monitoring of compliance except if a vessel is boarded at sea, and that the entry of layover day data into the central computer would be manual, increasing the cost and margin for error.

Mag-Strip Identification Cards: Under this proposal, each vessel would be issued an identification card encoded with the its permit number. Automatic-dialing terminals, similar to the credit-card verification machines used in a number of retail businesses,

would be located at convenient sites, similar to those listed in the previous option. Alternatively, they could be purchased or leased by the vessel captain and kept at home. Upon departure and on return from a trip, the captain would use the device to automatically register the status of the vessel, "in" or "out". The information would be sent directly to the computer, providing timely monitoring and non-manual data entry. The ID card would be required onboard whenever the vessel is at sea.

The relative cost of the equipment for this system is minimal. Individual card readers which connect to a telephone line cost about $265 (discounts may apply if large quantities are ordered). Assuming that there might be 500 locations where these card readers would be needed (at dealers, suppliers, docks, etc.), the total industry cost is estimated at $132,500. NMFS would be required to purchase some equipment and absorb the recurring costs to manage this system (Table 25).

In addition to its low cost, this system has the advantage of possibly integrating layover monitoring and landings data collection via a credit card based system designed to record landings. The negative aspect of this type of system is the potential to circumvent the system. Unlike a transponder system, a magnetic card only transmits a vessel's status twice (at trip departure and termination). The magnetic card would have to be onboard a vessel while it is fishing for scallops. The U.S. Coast Guard could determine whether a vessel is logged as being at-sea, but would not be able to verify how long the vessel had been at-sea. In other words, a duplicate card might be used to log in the vessel while it is at-sea through radio communication.

I. Alternatives Not Being Considered at this Time

1. Size limits

Compliance would be easier with a minimum size limit for scallop shell heights. However, as a sole measure, it would not be effective in capping effort and, therefore, fishing mortality on fully-recruited scallops. At current fishing levels, substantial increases in minimum shell heights would be needed to comply with the rebuilding guidelines for an overfished resource.

Since most scallops are landed by vessels that shuck scallops at sea, enforcement of a minimum size would be difficult. A minimum size on scallop meats (so that a minimum size could be enforced dock-side) would cause many of the same enforcement problems the current meat count standard.

2. Closed seasons

Because scallops grow rapidly at the ages that recruit to the fishery and because scallop yields vary seasonally due to spawning and for other reasons, closed seasons could be very

effective in increasing yield per recruit. Industry advisors have recommended against this alternative because it would disrupt the seasonal supply of scallop meats and it would do little to extend the current abbreviated age distribution.

3. Closed areas

Because scallops sometimes aggregate by size, closed areas might be an effective means to reduce the harvest of small scallops. Fishermen often report the presence of aggregations of small scallops, commonly known as "peanut piles". These areas, however, usually cover small portions of the resource area and would be difficult to enforce. Monitoring the presence of small scallops and opening and closing these areas to fishing would require substantially more survey efforts than currently exist. ME, however, uses a form of this management to control the harvests of scallops from its waters.

4. Fishery quotas

Fishery quotas are not being considered as an alternative for the same reason the adjustable trip limit option is not preferred. With an abbreviated age distribution, the wide variations in observed recruitment and the short notice when this recruitment is observed by the survey, the PDT concluded that it would be difficult to accurately set a quota to achieve a fishing mortality objective. This conclusion is explained in Appendix VI.

5. Vessel quotas

Vessel quotas have the same problem as fishery quotas, it is difficult to accurately set an annual quota from current data. Quota allocations, transferrable or not, have met with considerable resistance by the fishing industry. Current acceptance of this form of management in New England is poor.

VI. AFFECTED ENVIRONMENT

A. Introduction

Amendment #4 to the Sea Scallop FMP encompasses resources that lie within three distinct geographic regions - the Gulf of Maine, Georges Bank and the portions of the continental shelf south of New England to Cape Hatteras, NC (Figure 3). The topographic and oceanographic characteristics of each region are different.

B. Sea Scallop Life History

1. Distribution of sea scallops

The Atlantic sea scallop, Placopecten magellanicus (Gmelin), occurs only in the Northwest Atlantic on the continental shelf from the north shore of the Gulf of St. Lawrence, Strait of Belle Isle, (52°30'N latitude), south to Cape Hatteras, NC (35°30'N latitude). At the extremities of the range, sea scallops are sparse and widely scattered. Figure 3 shows the population densities for Georges Bank, Southern New England, and the Mid-Atlantic. The Gulf of Maine is not well sampled by NMFS surveys, therefore scallop densities were not plotted for this area.

Sea scallop populations of sufficient extent and density to support commercial fisheries occur from Virginia Capes (36°50'N) to Port au Port Bay, Newfoundland (48°40'N), with fishing grounds off Virginia Capes; off New York City; around Block Island, RI; on Georges Bank; off Cape Cod; along the coast of ME; the Bay of Fundy, particularly off Digby, Nova Scotia; the southern Gulf of St Lawrence; Scotia shelf (Browns Bank, Emerald Bank, Sable Island Bank, Banquereau); Port au Port Bay and St. Pierre Bank (Bourne 1964a; Naidu and Anderson 1984; From Brand 1991).

The sea scallop is a cold water animal. Adult scallops do not survive much above 20°C (68°F) (Posgay 1953; Dickie 1955). Thus, the summer average 20°C bottom isotherm that leaves the shore of Cape Hatteras and sweeps northward until it parallels the bottom contours at about 55 fathoms is considered to mark the sea scallop's southern boundary. Its northern boundary is apparently determined largely by summer temperatures either falling to reach that which induces spawning or prolonging larval development with resulting poor spatfall. Populations in areas with unstable hydrographic conditions may suffer sudden mass mortalities when exposed to rapid temperature changes caused by oscillations in the depth of the thermocline (Dickie and Medcof 1963). Direct temperature kills of all ages of sea scallops occur when temperatures rise to 20-35.5°C (Dickie and Medcof 1963). Scallops have been collected from waters with temperatures ranging from 1-19°C (Shumway, unpublished). No data are available on lower lethal temperatures for this species. The optimum temperature for growth is 10°C (Posgay 1953, MacDonald and

Thompson 1985b).

The spat of P. magellanicus must have a hard substrate on which to settle and do not survive on shifting sand bottoms (Merrill and Edwards 1976). Suitable substrates include rocks, old scallop shells, navigational buoys, seaweeds and other animals. Once the adult scallops have detached and settle on the sea floor, they prefer coarse sand, gravel and rock substrates; although they have been found on soft mud bottoms (Bourne 1964a).

P. magellanicus is a stenohaline species restricted to oceanic waters of fairly high salinities. Culliney (1974) found that sea scallop larvae remain viable in 10.5‰ and swam about normally at salinities from 16.9-30.0‰. Low salinities may affect scallop survival in shallow coastal areas where there is freshwater runoff (Johannes 1957).

The normal depth range for P. magellanicus is 18-110 meters, but it may occur in waters as shallow as 2 meters in northern areas (Naidu and Anderson 1984) and as deep as 384 meters (Merrill 1959). In southern areas they are rarely found at depths less than 55 meters (Squires 1962), primarily due to temperature variation with depth (Bourne 1964a).

2. Spawning

The sexes in sea scallops are separate and can be distinguished by their color as the gonads ripen prior to spawning. The ripe gonads are creamy white in males and bright coral red in the females. Mature gametes have been seen in females as young as 1 year (Langton et al. 1987) and scallops have been reported to spawn after their first growth ring has formed (25-35 mm) (Naidu 1970). Most sea scallops become sexually mature by the spring of their third year, but these small scallops may not produce many eggs. By age 4 (85-90 mm) a female will release about two million eggs. Egg number is directly related to shell height and maximum egg production is not reached until several years after maturity. It is estimated that scallops produce from 1-270 million eggs per individual (Langton et al. 1987). Gonad output (egg number) is greater in scallops from shallow water (10-20m), where the food supply is greater and temperatures are higher, than in scallops from deep water (170-180m) (MacDonald and Thompson 1986; MacDonald et al. 1987; Barber, et. al.,1988).

Spawning generally occurs synchronously when the males extrude sperm and the females release eggs en masse into the water, but it may occur over a more protracted period of time depending on environmental conditions. It has been suggested that year-class strength may correlate with the degree of spawning synchrony, rather than fecundity per se (egg number) (Langton, et al. 1987).

In the past, researchers believed that there was only one spawning event annually and that the timing of spawning in sea scallops varied with latitude, starting in the summer in the

southern areas and in the fall in northern areas. In support of this theory MacKenzie et al. (1978) reported that off the coast of NC and VA, spawning generally occurred as early as July and that further north on the Mid-Atlantic shelf spawning occurred in August. Recently, however, researchers have discovered that, on the Mid-Atlantic shelf south of the Hudson Canyon, biannual spawning occurs in the spring and the fall (DuPaul et al. 1989a; Schmitzer, et al. 1991). Using conventional time series methods, Kirkley and DuPaul (1991a) found that the spring spawning is the more predictable and dominant spawning event, and the fall spawning is minor and temporally-erratic, sometimes not occurring at all.

North of Hudson Canyon there is generally a single annual spawning event starting in the late summer or early fall. On Georges Bank spawning occurs in late September or early October (MacKenzie et al. 1978; Posgay and Norman 1958). In the Gulf of Maine spawning occurs in August and September (Barber, et al. 1988; Culliney 1974; Drew 1906; Robinson et al. 1981; Welch 1950). In the Bay of Fundy the spawning period extends from August to late September (Beninger 1987; Dickie 1955). Off the coast of Newfoundland, scallops spawn in August and September (Thompson 1977). Naidu (1970) also reported spawning by a few animals in June in Port au Port Bay, Newfoundland, but this spawning was considered to be minor.

The mechanisms that trigger mass spawning in sea scallops are not fully understood (Posgay 1982; Bourne 1964a). Posgay (1953) suggested that scallops need to be exposed to waters of approximately 10-12° C with subsequent cooling to initiate spawning. He postulated that spawning was triggered by the first sudden water temperature drop following the summer maximum. Similarly, the onset of vertical mixing in the water column, causing bottom temperatures to rise, is a possible stimulus. However, temperature changes do not explain the onset of spawning on Georges Bank where tidal currents keep the water column well mixed in all seasons, nor does it explain the occurrence of spawning in spring and summer. It appears that once the gonads are mature, any number of stressful events may induce spawning. Other possible stimuli include prolonged exposure to physical shock (Naidu 1970) wave action, onshore winds, changes in pressure (Culliney 1974; Naidu 1970; Stevenson 1936), and the presence of sperm in the water which induces the females to shed their eggs (Posgay 1953).

3. Larval distribution

After fertilization the eggs are slightly heavier than sea water and probably remain on the sea floor as they develop into the first free-swimming larval stages. The larval stages, trochophore and veliger, are pelagic (occurring in the water column). The larvae remain planktonic for over a month after hatching (Posgay 1982). A description of larval development in the laboratory has been published by Culliney (1974) and growth of larval scallops in the laboratory has been studied by Hurley and Tremblay (1986).

Identification of planktonic sea scallop larvae in the wild has only recently been described (Tremblay, et al. 1987) and the distribution of larval scallops is still largely unknown. Because scallop larvae are planktonic, speculation about their movement is based largely on the flow of currents in and around spawning areas.

The mechanism by which recruitment occurs in major production areas is conjectural at this point. The beds on Georges Bank, particularly in the vicinity of the Northern Edge, Northeast Peak and Great South Channel, are thought to be self-sustaining at a fairly consistent and relatively high rate of recruitment. This is because the larvae are probably retained in the Georges Bank gyre long enough for metamorphosis to be complete. During the spawning season in September, the water currents form tight gyrals which confine the sea scallop larvae to Georges Bank area prior to settlement. Good year classes on Georges Bank are associated with tight autumnal gyrals and poorer year classes are associated with loose gyrals (Posgay 1950).

Recently, Tremblay and Sinclair (1986) collected scallop larvae in the Bay of Fundy, Scotian Shelf and Georges Bank. They found that there was transport of larvae within the Bay of Fundy and Georges Bank via the residual current, but that most larvae either remained in or were returned to the area of major spawning. Their data also indicated that there was no evidence of exchange between Georges Bank and the Scotian Shelf.

There is considerable uncertainly about the mechanism involved in recruitment to the Mid-Atlantic. Beds in productive areas, such as the New York Bight, may not be self-sustaining, but may supply recruits for beds located further down-current. The occasional heavy recruitment to the Mid-Atlantic may be the result of periodically occurring optimum reproductive conditions, or augmented recruitment from spawning on Georges Bank.

It is not known if the beds on the coast of ME or in deeper waters of the Gulf of Maine are self-sustaining.

4. Sea scallop spat

At the end of their pelagic existence, the larvae enter the pediveliger stage with the development of a foot which is used to attach to hard surfaces. Spatfall (the settling of juvenile scallops to the bottom), and the period immediately following, is thought to be a time that is particularly important in the formation of scallop beds (Posgay 1953) and in determining year class size (Bourne 1964a; Caddy 1975). The transition from a pelagic to a benthic (occurring on the ocean bottom) existence is accompanied by drastic changes in diet, morphology and locomotory ability and it is conceivable that mortality may be as high during natural settlement as when spat are reared artificially (Bourne 1964a; Culliney 1974).

The availability of suitable surfaces on which to set seems to be universally accepted as a primary requirement for successful scallop reproduction. Spat do not survive on shifting sand bottoms (Merrill and Edwards 1976). Scallop spat settle on the shells of dead or discarded adult scallops (Caddy 1968), on the underside of pebbles and glass fragments (Culliney 1974), on navigation buoys (Merrill and Edwards 1976), on the bryozoan, Gemelleria (Baird 1953), on the red alga Rhodomela conferroides (Naidu 1970), on the hydrozoan Hydrallmania and on the tubes made by amphipods (Larsen and Lee 1978). In a review of the culture of sea scallops, Young-Lai and Aiken (1986) documented that artificial substrates such as nylon, netting, burlap, fiberglass, and polyethylene film will collect spat (Naidu and Scalpen 1976), but monofilament gillnetting proved to be the best (Naidu et al. 1981a,b).

5. Movement of sea scallops

Young adult sea scallops (larger than 10 mm long) detach from the hard substrate and settle to the sea floor. They adhere to the bottom by byssal threads which can be severed by the scallop when it swims in the water column.

Scallops are relatively active until they are about 80 mm long, swimming in response to disturbances, such as predation (Baird 1954) and commercial dredging (Caddy 1968). Direct observation of the reaction of scallops to dredges indicates that the young scallops are capable of avoiding an approaching dredge by swimming out of its path (Edwards and Emery 1968). While swimming, young scallops can also be carried long distances by currents (Baird 1954).

There is no evidence of mass migrations by scallops. The movements of sea scallops are usually localized and random or current-assisted. Numerous tagging experiments have shown that once aggregations of adults are formed, they remained fixed (Baird 1954; Dickie 1953; Naidu 1970; Schick 1979). Several researchers have reported movement of tagged scallops on Georges Bank in the direction of the current (Melvin et al. 1985; Posgay 1981).

6. Adult feeding behavior

Sea scallops are filter feeders, which feed by filtering food particles out of the water over the gill surfaces and then transporting the trapped food along tracks of beating cilia to their mouths. The general anatomy and surface microanatomy of all regions of the gill have been studied recently by Beninger et al. (1988). Particles which are too large to be ingested are rejected by the labial palps (organs located just below the mouth) and passed into the water current moving out of the mantle cavity. The mantle cavity is formed by the scallop relaxing its adductor muscle, allowing the two valves to gape slightly. The gap is closed together around the circumference of the shell, except for two spaces left open near each ear of the hinge. Water, bearing food and oxygen, is drawn in through one of these spaces, the

in-current siphon, and feces, pseudofeces, and other metabolic products are expelled through the other, the ex-current siphon.

Sea scallops are considered opportunistic filter feeders which feed on both pelagic and benthic organisms. They feed on seston (plankton and organic detritus). Analysis of their gut contents reveals numerous species of phytoplankton, diatoms and microscopic animals (such as peridinians, tintinnids, ciliate protozoa), pollen grains, detrital material and bacteria (Bordon 1928; Stevenson 1936; Shumway, et al. 1987). Sea scallops exhibit some capabilities for selective feeding, with some pre-ingestive selection of cells on the labial palps. In a recent study by Shumway et al. (1987), shallow water sea scallops fed equally well on benthic and pelagic food, whereas in deep water scallops fed primarily on benthic species.

The amount of food available to the sea scallop is the greatest single factor affecting growth, with temperature and current structure also playing significant roles (Stevenson 1932). More favorable conditions are usually associated with shallow water, where the food supply is higher and temperatures are higher than in deep water. Decreasing rates of growth with increasing depth has been documented by several authors (MacDonald and Thompson 1985a,b,; 1986; Schick et al. 1992).

In a Gulf of Maine study comparing shallow water and deep water sea scallops, shallow-water scallops had heavier more concave shells, significantly more tissue and double the amount of marketable meats when compared with animals of comparable height and age from the deep-water populations (Schick et al. 1992.). In the Bay of Fundy, such a change in growth with depth is not evident, presumably due to strong tidal mixing which creates a homogeneous water mass in terms of temperature and food (Caddy 1970; MacDonald and Thompson 1985a).

There are also seasonal changes in meat weight in sea scallops along the coast of ME (Robinson, et al. 1981), in Port-au-port Bay, Newfoundland (Naidu 1970), off Asbury Park, NJ (Gould 1983) and for populations from Georges Bank, Mid-Atlantic, the Gulf of Maine, Cape Cod Bay and Narragansett Bay (Serchuck 1983). In all cases the meat weight was greatest in the spring and least in the summer.

In a recent series of experiments, it has been demonstrated that flow rate can greatly affect food availability, feeding rates and hence, growth rates of sea scallops (Wildish and Kristmanson 1988; Wildish and Saulnier 1992; Wildish et al. 1987; 1992). Growth was inhibited at flow velocities of greater than 10-20 cm / sec. Sea scallop behavioral responses to changing seawater flow velocity include: 1) recessing into the sediment (Caddy 1968) so that the valves just protrude into the benthic boundary layer where velocities are reduced due to frictional drag on sediments, and 2) rotational movements (Bourne 1964a) so that the exhalant opening faces away from the direction of the major seawater flow and thus avoids flow-induced feeding inhibition at relatively low flows (Wildish et al. 1987). High current

velocity inhibits sea scallop filter feeding. Scallops may occur in areas having fast currents if the current slackens to optimal rates for feeding about one-third to two-thirds of the time (Wildish and Kristmanson 1988).

7. Predation

Scallop larvae are planktonic, so they are potentially preyed on by filter feeders and planktonic carnivores (Langton and Robinson 1990).

Medcof and Bourne (1964) reported that small juvenile scallops were ingested whole by the sun starfish Crossaster papposus. Naidu and Scaplen (1976) reported that juvenile starfish, Asterias vulgaris, were the principle predators of scallop spat in spat traps in Newfoundland.

Juvenile scallops have been found in the stomachs of cod (Medcof and Bourne 1964), wolffish (Medcof and Bourne 1964), American plaice (Medcof and Bourne 1964; Naidu and Meron 1986; Robert et al 1986), yellowtail flounder (Naidu and Meron 1986) and eel pout (Bigelow and Schroeder 1953).

Elner and Jamieson (1979) found under laboratory conditions that crabs, Cancer irroratus, and lobster, Homarus americanus, crushed and consumed scallops up to 70 mm shell height with a predation rate of up to 3 to 10 scallops per day. Scallops larger than 70 mm were immune to predation by even comparably large rock crabs and lobsters. ("The relevance of such laboratory findings to the situation in the natural environment, where the scallop is free to swim away from the predator, is not clear." from Brand 1991.)

C. Habitat and Physical Environment

The Gulf of Maine is bordered on the east, north and west by the coasts of Nova Scotia, New Brunswick and the New England States. To the south, the Gulf is open to the North Atlantic Ocean at the surface. Below about 50 meters depth, however, Georges Bank forms a southern boundary for the Gulf, making it semi-enclosed. The Gulf is connected to the deep North Atlantic Ocean by only three channels - the major passage being the Northeast Channel between Georges Bank and the Scotian Shelf. The interior of the Gulf is characterized by deep basins (>200 m) which are separated by irregular topography that includes a number of shallow ridges, ledges and banks. The largest and deepest basins are Georges Basin near the mouth of Northeast Channel, Jordan Basin to the northeast and Wilkinson Basin in the southwestern Gulf. Jordan and Wilkinson basins are separated by irregular, shallower topography that extends toward the central Gulf from the Casco Bay - Penobscot Bay coastal region, and includes Jeffreys Ledge, Platts Bank and Cashes Ledge.

1. Bottom characteristics

The bottom type within the Gulf is quite patchy and generally related to the topography (Schlee 1973). The deep basins exhibit silty clay or clay sediments, while the irregular topography between basins generally has a higher fraction of sand. The topographic highs within the Gulf are exposed to the winnowing action of the currents and are characterized by sand and gravels. In the near coastal regions (within about 10 miles of the coast) the bottom type south of Casco Bay is largely sand, while to the north and east is generally a finer fraction of silt and clay (Schlee 1973). However, the bottom type, particularly in coastal and estuarine areas, may exhibit a large degree of small-scale variability (for example see Butman et al. 1992, Figure 5). The distributions of benthic species and assemblages of species in the Gulf of Maine are strongly related to the bottom type and the properties of the water overlying the bottom (Watling et al. 1988).

Georges Bank is a large (300 x 150 km) shallow bank that appears to be an eastward extension of the U.S. continental shelf. The Bank has a steep slope on its northern edge and a broad, flat, gently sloping southern flank. It is separated from the rest of the continental shelf to the west by Great South Channel. The central region of the Bank is quite shallow, with areas less than 10 meters deep, and the bottom there is characterized by large amplitude sand waves (Emery and Uchupi 1972). The rest of the Bank is sandy and flat, with some regions of gravel on the northern and eastern parts of the Bank (Valentine and Lough 1991).

The continental shelf south of New England is broad and flat. The bottom is generally sandy, except for an area on the outer shelf southwest of Martha's Vineyard that is silt (Garrison and McMaster 1966). Southeast of Nantucket is a shoal region (Nantucket Shoals) that has sand waves (similar to those on central Georges Bank) and patches of gravel on the western flank of Great South Channel.

2. Water circulation

The waters in the region originate from two primary sources, water from the Scotian Shelf (Scotian Shelf Water - SSW) and water from the continental slope offshore (Slope Water - SLW). The SSW enters the Gulf of Maine around Cape Sable in the near surface layers (Smith 1983), while the SLW enters at depth through Northeast Channel (Ramp et al. 1985). The two water types mix together as they travel in a general counterclockwise motion around the Gulf. Near the coast the currents also move the waters in a general counterclockwise direction along the coast, except south of Penobscot Bay region where a portion of the coastal flow turns offshore toward Jeffreys Ledge and the shallow topography between Jordan and Wilkinson Basins (Brooks 1985). From the southwestern Gulf, the surface waters over Wilkinson Basin enter a clockwise gyre on Georges Bank which takes the water eastward to the northeast part of the Bank and then southwestward along the Bank's broad southern flank (Hopkins and Garfield 1981). From there, most of

the water flows westward south of New England and through the Middle Atlantic Bight. Some portion of the flow from the southern side of Georges Bank turns northward through the Great South Channel to recirculate around the Bank (Butman et al. 1982). The mean residence time for water in (or travel time through) this region is approximately 1.5 to 2 years.

This mean circulation of water through the region is characterized by velocities of 5 to 20 cm / sec. However, the actual water motions at any time are dominated by tidal currents and by local wind-induced flow. Surface velocities often range from 20 to 100 cm / sec. The Gulf of Maine is in near resonance with the M2 tidal component (Garrett 1972) which results in large tidal currents (80 cm / sec) in the eastern Gulf-Bay of Fundy region, while the western Gulf has tidal currents of 10 to 20 cm / sec at the surface (Moody et al. 1984). The shoal region of Georges Bank also experiences large tidal currents of 70 to 100 cm / sec (Moody et al. 1984).

3. Water masses

The water properties in the Gulf vary in both time and space. The primary temporal variability is associated with the seasonal cycle (e.g., winter cooling, summer heating). Spatially, the properties vary a) vertically, b) in the east-west direction across the Gulf, c) and between the near coastal regions and the more central portions of the Gulf.

Vertically, the water column in the Gulf of Maine is characterized by three layers. The surface layer (0-50m) is relatively fresh (31-33 PSU). Its temperature changes greatly through the year as a result of seasonal heating and cooling. An intermediate layer is found at Mid-depths (50-100m) and is identified by a temperature minimum which results from vertical convection driven by surface cooling and wind mixing during winter (Hopkins and Garfield 1979). As the surface layers warm through the spring and summer, the intermediate layer remains cool, forming a temperature minimum in the water column that is a remnant of the previous winter's cooling. The deeper portions of the Gulf contain the Maine Bottom Water, which originates from the Slope Water entering through the Northeast Channel and is warmer and saltier than the intermediate layer above it (Mountain and Jessen 1987).

The surface layer of the Gulf experiences a large seasonal cycle in temperature due to surface heating and cooling. The surface temperature ranges from about 4°C in March across the Gulf to about 18°C in the western Gulf and 14°C in the eastern Gulf during August. The salinity of the surface layer also varies seasonally, with minimum values in the west occurring during summer, from the accumulated spring river inflow, and during winter in the east, from the low salinity of the in-flowing Scotian Shelf water. (This low in salinity originates from the peak outflow of the St. Lawrence river system at the northern end of Nova Scotia during the previous spring). The seasonal range in the surface layer

salinity is about 0.8 PSU, but can vary between years with the changes in the amount of precipitation and river inflow. With the seasonal temperature and salinity changes, the density stratification over the upper layer also exhibits a seasonal cycle. From well mixed, vertically uniform conditions in winter, stratification develops through the spring and reaches a maximum in late summer. The degree of stratification is greater over the western Gulf than in the eastern half.

The bottom waters of the Gulf exhibit a significant east-west difference in water properties that is larger than the seasonal variability (Mountain and Jessen 1987). In Georges Basin, near the inflow of Slope Water through Northeast Channel, the bottom water has properties of 6 to 9 °C and 34 to 35 PSU, while in Wilkinson Basin the values are 4 to 7 °C and 33 to 34 PSU. Jordan Basin is intermediate between the other two basins.

Conditions near the coast of the Gulf of Maine are greatly influenced by local river input. The incoming fresh waters mix with the coastal waters and form a low salinity, coastally trapped band of water which can extend 20 km or more from the coast. The dissolved and particulate content of the river inflow (e.g., nutrients, sediment, contaminants) is transported by the coastal currents and dispersed along the near coastal region. The coastally trapped band also transports phytoplankton and can influence the temporal and spatial distribution of toxic phytoplankton blooms in the southwestern Gulf (Franks and Anderson 1992b).

The waters on Georges Bank and on the shelf south of New England are similar in properties to the upper layers of the Gulf of Maine. The annual range in surface temperature is from about 4 °C in winter to about 15 °C on Georges Bank and about 20 °C on the southern New England shelf during August. The water column develops thermal and density stratification with the seasonal surface warming. The bottom temperature on the deeper parts of the Bank and the shelf reach a maximum of about 12 °C. The shallow (<60 m) central portions of the Bank and Nantucket Shoals do not seasonally stratify, but remain vertically uniform year round due to the mixing of the strong tidal currents.

Oceanographically, the southern or offshore boundary of Georges Bank and the continental shelf is marked by a region of sharp gradient in water properties between the bank/shelf waters and the Slope Water further offshore. The gradient region is termed the shelf/slope front and extends downward from the surface to intersect the bottom near the 80 to 100 meter isobath.

4. Faunal associations

Research on scallops has focused primarily on the scallops per se and fishery related issues rather than the ecology of the scallop ground or associated fauna. Several investigators have, however, documented their relationship between scallops and different species of

fish while others have described the megafaunal components of scallop grounds in the Gulf of Maine. Predator-prey relationships have also been described for a number of fish and invertebrate species. These data are summarized below.

Several species of fish have been reported to have commensal relationships with sea scallops. Juvenile red hake have (Urophysis chuss), for example, been reported to inhabit the mantle cavity of scallops (Goode, 1884; Musick 1969; Steiner et all. 1982). When the fish is too large to hide within the scallop's shell, the relationship still continues. Wigley and Theroux (1971) have described a symbiotic relationship between post-juvenile hake and P. magellanicus; a specimen up to 30cm in length was photographed partially encircling a sea scallop on Georges Bank. Sea snails have also been found within the scallop shell. Able (1973) found that these fish are found within the scallop's mantle cavity from July and August through December but, unlike the larger red hake, they subsequently abandon their host and migrate inshore for spawning.

Caddy (1970) conducted an extensive study of the scallop grounds in the Digby area off Nova Scotia in the Gulf of Maine. These data were analyzed to determine faunal adjacencies in Caddy and Carter (1984). They observed fifty-two taxa on the scallop ground with the most frequently occurring group being sea anemones. They also observed megafaunal community zonation relating to both depth and sediment type. Only 10% of the faunal adjacencies were non-random and most of these associations reflected a predator-prey relationship. In another study of scallop grounds in the western Gulf of Maine, Langton and Robinson (1990) found over 26 taxa but limited their description to the three dominant megafaunal invertebrates; a sabellid worm, sea anemone and the sea scallop. All three species occurred in patches and showed different associations with each other, potentially a result of the amount of scallop dredging in the area.

A variety of predators of sea scallops from the different life stages have been identified over time and many of them are included in a tabular listing in Shumway (unpublished data). The predators are listed here together with the source of information: Gadus morhua, (Medcof and Bourne 1964); Hippoglossoides platessoides, (Medcof and Bourne 1964; Naidu and Meron 1986); Anarhichas lupas, (Medcof and Bourne 1964; Nelson and Ross 1992); Pseudopleuronectes americanus, (Caddy 1968, 1973); Macrozoarces americanus, (Bigelow and Schroeder 1953); Myoxocepohalus spp., (Caddy 1968, 1973); Cancer irroratus, (Elner and Jamieson 1979); Asterias vulgaris, (Young 1930a,b; Caddy 1968, 1973); Homarus americanus, (Elner and Jamieson 1979); Lunatia heros, (Young 1930a,b); sea anemones, (Mackenzie 1979; see also Langton and Robinson 1990); and plankton feeders, (Bourne 1964b).

D. Description of the Fishery

1. History of the fishery

The history of the sea scallop fishery has proven to be exceptionally rich, but poorly documented. The information provided here is at best a broad overview of developments over a period of several centuries.

Early Use of Sea Scallops: The use of scallops along the Atlantic coast extends back into prehistory. The first written record is nearly four hundred years old and mentions their use in Nova Scotia by French colonists in 1605. There are additional seventeenth century accounts of scalloping, and the first mention of a commercial fishery is from Halifax, in 1862 (Bourne 1964a, Smolowitz 1992).

Development of the Commercial Fishery in Maine: The beginnings of a commercial scallop fishery in the U.S. is not clearly documented, but it apparently began around the same time as the Halifax fishery. In 1886, the fishery along the ME coast was recognized in an article in the American Naturalist, which claimed that sea scallops had been overfished nearly to the point of extinction (Smolowitz 1992). This was challenged a few years later by exploratory beginnings at least as early as 1865. An 1876 canning venture in Castine, ME, and a more sustained fishery in the same area in the mid-1880s developed shortly afterwards (Smith 1891, Smolowitz 1992).

Initially, ME fishermen used oyster dredges to catch sea scallops. These consisted of a handle and a rectangular dredge mouth of iron bars, with a bag of small iron rings on the bottom and twine netting on the top and sides (Smolowitz and Serchuk 1988). These may be similar to what contemporary ME fishermen describe as "the old rope gear", which had no "cutting bar" but only "a chain stretched around". Although there were early experiments with steam vessels, the dredges were pulled from rowboats or sailboats operated by two men. Progressively modified, the dredges became known as Digby-type dredges or rock or tumbler drags (Smolowitz and Serchuk 1988). ME scallopers today often call the dredge a "drag."

As recently as 1908, the U.S. sea scallop fishery was located almost exclusively in the state of ME. About 1,350,000 pounds of scallop meats were landed in ME that year (Smolowitz 1992).

Early Expansion in the Mid-Atlantic Region: In 1913, the GRAMPUS (a U.S. Bureau of Fisheries schooner) discovered extensive scallop beds in the Mid-Atlantic region from NY to VA (Welsh 1914, Smolowitz 1992). The Bureau of Fisheries recommended that, because of the smooth (sandy or muddy) bottoms, the fishery be developed using a modified flounder trawl net (Smolowitz and Serchuk 1988); this became the progenitor of the modern scallop trawl.

Mid-Atlantic ports soon became predominant in the scallop fishery. By 1929, landings in the area were in excess of 2 million pounds (Smolowitz 1992). Norwegian immigrants, who initially settled in Brooklyn, NY, participated in developing the Mid-Atlantic fisheries in the 1930s. Many would later move to Fairhaven / New Bedford, MA. Discovery of scallops on Georges Bank took place in the late 1930s. The daughter of one of the Norwegian pioneers said they fished for butterfish during the winter and went to Georges for summer scalloping. She said, "It's a lot like those boats from the South, now; they'll make at least one stop in New Bedford during the summer, even if they go back home the next trip."

Later Expansion, Georges Bank and Mid-Atlantic: As noted, the Georges Bank scallop beds were discovered in the late 1930s, and by 1941 over 70% of U.S. scallops were being landed in New Bedford (Smolowitz 1992). A key event in the move of Norwegian immigrants into the New Bedford area from NY is reported to have been the establishment of a Lutheran Church in Fairhaven. New Bedford has been the most prominent scalloping port in the U.S. ever since the 1940s.

A distinct type of dredge, called the New Bedford dredge, came into use. Its key features include a massive "cutting bar" on a rectangular frame, one or more sweep chains, and a collection bag made up largely of metal rings. New Bedford dredges exhibit a great deal of variation in rigging details, depending on fishing conditions (Smolowitz and Serchuk 1988).

Canadian scallopers were reportedly working in the VA-NC area in the 1940s. Later, in the 1950s, Canadian boats would become a major factor in exploitation of the eastern part of Georges Bank. New Bedford, meanwhile, became a model for self-regulated fisheries.

In New Bedford from the 1940s through 1959, the scallop fishery was self-regulated by agreements among union fishermen. The self-regulation regime included crew limits, trip length limits, and a mandatory layover period as well as catch limits. This ceased through legal action in 1959.

U.S. scallop landings exceeded 5,000 metric tons (mt) for the first time in 1946, and would fall below that level again only in a single seven-year episode from 1969 through 1975. In the mid-1960s, scallop abundance declined on Georges Bank, and finfish prices coincidentally began to increase. Many scallopers switched to dragging for fish. The eastern portion of Georges Bank was effectively abandoned by U.S. scallopers, and became a predominantly Canadian grounds.

The local NC industry is reported by a Wanchese man to have begun between 1956 and 1960. He said, "We had beds all the way down to the old 2200 line, around the state line between NC and VA. They were 'dinner plates,' really big scallops." NMFS records show the NC scallop fishery to have been significant by the mid 1970s. Otter trawls were used

more frequently for scalloping, and shell-stocking was a common practice.

A New Bedford fisherman reports the discovery of "tremendous concentrations of scallops, from Cape Hatteras to New York" in the mid-1970s. He said "They were bringing up so many, they could only shuck the bigger ones, and they were throwing the others away." Levine and McCay (1987) discuss technological changes during this time period, in the Cape May, NJ fishery. In 1976, U.S. scallop landings were nearly twice what they had been in 1975, increasing from 4,422 mt to 8,721 mt. During the latest 15 years (1977-1991), landings have exceeded 10,000 mt in all but 5 years. In the previous 89 years, landings had exceeded 10,000 mt in only 6 years (1953, 1955, and 1959-1962). The mid-seventies marked the beginning of the modern boom years.

The Boom Years: Beginning in the mid-1970s, increasing numbers of VA boats and other southern boats began appearing at Georges Bank and other New England scallop beds. One New Bedford scalloper reminisced that "the boats themselves couldn't hack it. I saw some of those Southern boats come in with the outriggers all bent up." Nonetheless, they persisted, and a few companies built fleets of boats designed for the heavier seas of New England.

Many relatively small shifts in fishing patterns are potentially significant in terms of management considerations, but accounting of such changes is inadequate. The following two paragraphs on the inshore ME scallop fishery are to be considered indicative, rather than definitive. They are offered only to suggest how complex the shifts may have been in the far more volatile and reactive large-boat fishery of New Bedford and ports further south.

Between 1973 and 1978, significant numbers of ME winter scallopers switched from dredging to fishing, either with bottom trawls or gillnets. Scallop prices were high, but the scallops were scarce. Many factors were involved in the decision to switch. Fishermen who switched from dredging to bottom trawling were younger than those who switched to gillnetting. Their decisions were related to their commitment to lobster fishing as a summer fishery and to their ability and willingness to invest money in an alternative to dredging (Acheson 1988a). This change reversed a previous trend which lasted into the 1970s of switching into scalloping from other fisheries (Acheson et al. 1980).

Despite the transition from dredging to fishing, participation in inshore winter scalloping remained high. Out of more than 2,200 full-time lobster fishermen in 1978, one-quarter switched to another fishery during the winter, and of those one-half switched to scalloping (Acheson 1988b). Some other ME scallopers switched seasonally from groundfishing. There were a total of 202 seasonal scallop vessels, in 1978 (Acheson et al. 1980).

Federal regulation was a major factor that changed the fishery. These came about five

years into the boom. In 1981, a draft FMP was issued calling for (1) adoption of size controls on scallops harvested (40-count, going to 30-count after a year, and 3¼" minimum shell heights going to 3½; (2) licensing of all participating vessels, and (3) mandatory data reporting for licensed vessels. This plan was finalized in January 1982. A further description of the regulatory changes and amendments to the Sea Scallop FMP is given in Section III.A.

2. Harvesting sector

a. Dredges

Most sea scallops are landed by vessels using scallop rakes (dredges or drags). Relatively small-sized gear types are used for fishing in shallow waters, including the Digby-type rake. On the other hand, the New Bedford scallop drag is widely used in the offshore fishery (Stone and Hurley 1987). Smolowitz and Serchuk (1988) provide a detailed account on construction and operation of dredge gear. Essentially, the drag consists of a heavy metal frame and a bag knit with steel rings 3 or 4 inches in diameter and variously interconnected with links (Bourne 1964a). Three inch diameter rings are most commonly used. The frame digs into the substrate by its own weight and in some cases by teeth that extend down from the leading edge of the frame.

The basic method of scalloping has not changed significantly since the 1982 Sea Scallop FMP. During the 1980s, however, the use of larger vessels have enabled fishermen to stay at sea longer as well as increase their dredge size. Other modifications to the basic gear configuration have been made to retain more scallops. Since most dredge vessels shuck scallops at sea, their fishing power primarily depends on crew size and the size of scallops in the catch. The use of chafing gear, cookies, and multiple linking between rings have become more prevalent. DuPaul et al. (1989b) provided a recent description of the industry practices and gear configurations in the scallop dredge fleet.

b. Trawls

Vessels equipped with trawl nets are more common in Mid-Atlantic waters, where scallop beds are generally on smooth (mud or sand) bottom. This forces trawl vessels to fish on sandy peripheries of Georges Bank. A trawl net is held open during towing by boards or "doors" on each side and the net tapers into a cod-end. This configuration is a modification of a two-seam flounder trawl. Unlike dredges, scallop trawlers generally land unshucked scallops which are processed shore-side. Most of their fishing effort is generated by the size of the net being towed and the vessel's horsepower. DuPaul et al. (1989b) compare several types of trawl configurations used commonly.

c. Deployment

Day trips: Inshore boats in ME and MA work day trips only. A typical trip leaves before dawn and returns after sunset. Frequent tows of the dredge are made while fishing. Activities of a ME boat are described by Mutch (1992).

Short Trips: Smaller draggers, whether from ME, MA, or NJ, make relatively short trips to areas a few dozen miles offshore. Trips of no more than five days were routine for the entire fishery until the 1950s. Now only small boats usually fish short trips. A ME scalloper described a typical trip as follows:

> "...our fishing grounds that we usually would fish on, would be Platts, Fippennies, down off the Portland area, and that's probably, oh, one of them's 35-40 miles out and the other one's probably close to 55, 60 miles out. ... I've fished anywhere from Block Island [RI] to the Canadian border to Georges. I've been everywhere up and down the coast. ...to steam my boat to Platts, usually I try to stay two or three days when I go up there in the summertime with the, decent weather and what not. And then I take my trip, oh, seven hundred to a thousand pounds, y'know, for a small boat. I've got a one-man crew, plus a shoveler I take with me, somebody to help me."

Extended and back-to-back trips: The biggest scallop boats, from MA, NJ, and VA, take much longer trips. Eight days is a short trip for the bigger vessels. Fishermen report that trips of ten to twelve days are not long enough to be profitable, and some boats take trips as long as 22 days. Some vessel owners, in order to squeeze more production from their boats, schedule fairly long trips on a back-to-back basis, i.e. the boat comes in, unloads its catch and takes on more fuel and supplies, and immediately goes back out. Crews rarely tolerate this, nor do they readily accept being off work for an entire trip. Reportedly, the most workable approach uses two boats with three crews, so that the boats stagger their trips. It gives the crew one-half a trip off and places them on the other vessel after their time off.

Migratory Trips: The great amount of movement in the sea scallop fishery is only one aspect which makes a simple characterization difficult. Not only do boats make routine movements from their home ports to remote fishing areas, but also boats make non-routine moves to other ports to get closer to different fishing grounds. This is well illustrated by the occasional appearance of boats from TX, MS, FL, and GA in NMFS statistics. Some of the migrant vessels stay, however, and adopt new principal ports which differ from their home port of registry. New Bedford attracts many boats that unload between summer trips to Georges Bank.

d. Vessel characteristics

The scallop fishery is usually one of the largest fisheries in the U.S. in terms of total ex-vessel revenue. Since implementation of the Sea Scallop FMP (NEFMC 1982), the number of vessels with landings recorded in the weighout data base increased from about 300 to 500 (Table 3). Even though there are about 150 vessels that fished in 1990, but not in 1988 or 1989, the number of active vessels appears to have leveled off since the 1989 control date was published.

Sutinen et al. (1992) estimated that in 1989 there were 510 medium and large offshore scallop vessels employing 6,000 full-time fishermen. These vessels ranged in size from less than 5 GRT to over 200 GRT (Figure 5). About 60, or 20% of the scallop fleet is composed of vessels larger than 200 GRT . Most vessels are between 110 and 200 GRT.

Almost 75% of these vessels were constructed since 1970 (Figure 6). A boom in new vessel construction occurred during the 1970s, coinciding with the 1978-79 peak in landings. Since that time, the construction of new scallop vessels has declined.

Full-time scallopers generally fish year round and the most active scalloper had 330 days at sea. Other scallop vessels may be considered part-time or occasional participants and the amount of landings varies seasonally and across resource areas. Sutinen et al. (1992) estimated that 75% of Georges Bank landings occur between April and September. In the Mid-Atlantic, 71% of landings occur between April and September. In the Gulf of Maine however, about 70% of landings occur between October and March. This pattern is partly caused by state regulations (Table 12) and partly by seasonal patterns in other fisheries such as those for lobster, groundfish, and shrimp, and in other industries.

e. Landings

Scallop landings in 1988 and 1989 were about equal to those during 1978-79, around 30 million pounds (Figure 2). Landings of 36 million pounds in 1990 and of 37 million pounds in 1991 were the highest ever. These landings were the result of historically high recruitment (NMFS 1992b) and an increase in standard[1] days fished from 18,889 days in 1980 to 43,014 in 1991 (Table 14). This increase in fishing effort was caused by increases in fleet size, the number of days at sea per vessel, and the effort contributed by large vessels. In 1980, class 4 vessels (>150 GRT) contributed 44% of the total effort. In 1991, these vessels contributed nearly 60% of the total effort. This large increase in fishing effort produced only slightly higher landings than earlier periods.
The average annual landings is about 19.9 million pounds between 1960 and 1991 (Figure 2). It is somewhat lower than the long-term potential catch (NMFS 1991b). Scallops

[1]Adjusted days fished account for variations in vessel size, gear type, and seasonality (Wigley and Serchuk 1992).

recruitment varies greatly and landings have reached about 30 million pounds (13,600 mt) during two periods, 1960-61 and 1978-79 (Table 15). These landings were produced by less than half the current effort.

Except for 1975 and 1976 when they peaked at nearly 25% of the total, scallop landings by otter trawls have remained below 10%. The average landings by otter trawl vessels averaged only 2.5% from 1982-1991. Trawl landings recently increased from 760,000 pounds in 1987 (2.6%) to 2 million pounds or 5.3% of the 1991 total (Table 16).

Landings from 1988 to 1990 by fishing area are shown in Figure 7. The New York Bight area provided the most scallops in both 1988 and 1989, 9 and 14 million pounds, respectively. The next most important areas were Great South Channel and eastern Georges Bank. In 1990, eastern Georges Bank provided almost 14 million pounds while the New York Bight fell to only 8 million pounds. For 1991, landings from Georges Bank remained high and increased slightly in the Mid-Atlantic region (Table 17).

Trawl landings, especially in 1988, occur primarily in the New York Bight and Delmarva areas (Figure 7). Minor amounts of scallops are also caught as a by-catch by surf clam dredges. Up to 100,000 pounds of scallops have been landed by hand (SCUBA) in the Gulf of Maine as part of a recreational and artisanal commercial fishery. These SCUBA landings are regulated by ME, NH, and MA a 3½ inch shell height standard (Table 12).

f. Fleet definition

The scallop fishery can be segmented into vessel groupings (Figure 8). Total landings by tonnage (> 5 GRT) scallop dredges were 29 million pounds in 1989, by far the largest amount by any single group (Table 17). They have not been included on Figure 8 in order to illustrate the landings by other groups. Three other groups landed about 1 million pounds each in 1989: tonnage otter trawls, undertonnage scallop dredges in the Gulf of Maine, and NC scallopers. Two other vessel groupings are undertonnage and unidentified vessels. The undertonnage group consists of under-tonnage boats not in the Gulf of Maine. The unidentified group consists of tonnage vessels, both dredges and trawls, which cannot be individually identified. Only the tonnage scallop dredges and tonnage otter trawls can be identified individually, and these two groups accounted for almost 93% of the scallop landings in 1989. Recreational SCUBA landings in the Gulf of Maine came from state waters and were about 100,000 pounds in 1989.

The distribution of landings among these vessel groups in 1988 and 1989 were: 88% by tonnage scallop dredges (310 dredges); 3% by tonnage otter trawls (229 trawls); 3% in the Gulf of Maine (mostly undertonnage); 5% in NC (98 permits in 1989); 1% by unidentified tonnage vessels. Landings by the tonnage scallop dredges were over 29 million pounds in 1989; 1.3 million pounds by tonnage trawlers; 1.2 million pounds from the Gulf of Maine;

1.01 million pounds from NC; and 115,000 pounds by unidentified vessels. The scallop fleet (larger than 5 GRT) can be divided into several categories according to total days at sea, the percentage of fishing time devoted to scallops, and the percentage of revenues derived from scallops. Three basic groups can be defined. The full-time scallopers are distinct from all others in that they devoted over 150 days at sea to scalloping and derive most of their income from scallops. Part-time scallopers have less than 150 days at sea, and although many are highly dependent on scalloping, their low participation rate makes restrictions on layover periods less practical without a defined season. Finally, occasional scallopers are characterized by very low economic dependence on scallops (Section VII.A.1). Layover restrictions would not reduce the fishing effort of vessels in this group. This vessels could easily add more trips to compensate for reduced fishing time. The entire scallop trawl fleet, except for one vessel, falls into the seasonal or occasional groups.

Full-time scallop dredges and otter trawls are responsible for 74% of the combined landings (1988 and 1989). Vessels in the seasonal group contributed 14% of total landings. Occasional dredges and trawls accounted for 3%, NC dredges for 2%, NC trawls for 2%, undertonnage Gulf of Maine dredges and trawls for 3.4%, and unidentified tonnage vessels for 1%.

Full-time dredges landed an average of between 7,000 and 10,000 pounds in 1989. In the Mid-Atlantic region, dredges averaged 7,000 pounds per trip. In New England, the catches averaged 9,000 pounds per trip. The mean catch per day at sea for 1990 had a modal value of 800 pounds, though catches of up to 1,000 pounds per day at sea were common (Figure 9). Part-time dredges landed 2,000 to 8,000 pounds per trip, with a large number of 1,000 pound trips. For this reason, the adjustable trip limit alternative classifies vessels as either part-time or full-time and has different trip limits for each. Part-time vessels had somewhat lower catches per day at sea than full-time vessels. The part-time fleet consists of two general categories of small vessels that fish close to shore and larger vessels that can travel further and fish in worse weather. The distribution of part-time catches per day at sea had a bimodal distribution, with one mode at 400 pounds and the other mode at 800 pounds. The preferred alternative's allocation of days at sea according to three vessel categories addresses the harvesting industry's structure and fishing patterns.

Total annual landings for vessels in the full-time fleet ranged from 70,000 to 250,000 pounds The amount of annual landings was evenly distributed, having no discontinuities suggesting differences in fleet behavior. Annual landings for individual vessels in the part-time fleet ranged from 400 pounds, the minimum landings that defines a directed scallop trip, and 155,000 pounds A similar, even distribution was noted for this group as well.

Most scallop effort is the product of dredges rather than trawls. Dredge vessels fished over 30,000 days at sea during 1987 and 1988, whereas trawl vessels fished about 4,000 days at

sea. Most trips by full-time scallopers lasted from 10 to 12 days during 1989. Trips by part-time vessels ranged from 1 to 15 days.

Most qualifying vessels land most of their trips in New Bedford (95 full-time, 42 part-time). Another 29 (15 full-time, 14 part-time) land most often in NJ, while 58 (45 full-time, 13 part-time) land scallops in the Hampton-Norfolk area. There are a significant number of vessels that land scallops in ME and NC. Although landings from these States are not completely covered by the weighout data collection program, the database shows landings for 12 part-time vessels in ME. Those that land in other States are probably included in the above totals.

g. Geography

The fishery mainly occurs in three geographical areas. Each area has a different mix of fishing methods and gear types. In the Gulf of Maine, a small fleet of boats fishes seasonally in waters relatively close to shore. Much of the fishery occurs within ME's territorial sea. These vessels generally use narrow dredges rigged to fish on hard, rocky bottom. In some areas, state regulations limit the dredge size to between 5½ and 8½ feet (Table 12). Some of these vessels fish seasonally for scallops, while others migrate to fish the Great South Channel and Georges Bank. Another fishery with similar characteristics occurs at Chatham, MA.

By far, the largest port for scallop landings is New Bedford, MA. The scallop fishery from this port and adjacent areas of Southern New England consists of predominately large vessels that use dredges and shuck scallops at sea. Only the adductor muscle, packed in approximate 40 lb. bags, are landed. Most boats are owner operated, but some owners hire captains to operate two or three vessels. Only a few vessels are owned by processors or dealers. This fleet is mobile and often takes extended trips of approximately seven to twenty-one days. Most scallops landed by this fleet come from the South Channel and Georges Bank, but when concentrations of scallops change, the fleet moves to other areas including the New York Bight and the Delmarva area. Dredges are often as wide as 15 feet across and are designed to fish on hard, rocky bottom.

In the Mid-Atlantic, the predominant ports are Cape May, NJ and Norfolk-Hampton, VA. A number of seasonal vessels operate out of Wanchese, NC. The fleet in this area is also composed of mostly large vessels, but substantially more use trawls to catch scallops. Unlike New England, the Mid-Atlantic scallop grounds have much more open, sandy bottom. Trawlers can fish without risk of serious damage. Many vessels in this area, especially trawlers, tend to land whole, unshucked scallops ("shell stock"), however landings of shucked scallops by dredges are common. Depending on conditions, dredges may land shell stock while trawlers sometimes land scallop meats. More often than in New England, vessels in the Mid-Atlantic are owned by dealers or processors. As in New

England, however, captains and crew are paid based on a share of the landings. Although this fleet is also mobile, most of the scallops landed in the Mid-Atlantic come from the New York Bight and the Delmarva region. Mid-Atlantic boats also take infrequent trips to the Great South Channel, but transit time from port can be 36 to 48 hours.

Inshore and Offshore Boats: Inshore boats which fish for scallops on a seasonal basis, generally avoid the "innovation treadmill" (Smolowitz and Serchuk 1988). These vessels are predominantly less than fifty feet, with open cabins, small gas or diesel engines, a hydraulic hauler and some very basic electronics equipment.

The inshore scallop boats of ME are mostly 35-45' lobster boats that fish for lobsters during the summer. Acheson (1988b) provides an accurate description of a typical ME lobster boat. These boats simply add booms and dredges for seasonal scallop dragging, permitted by state law between November 1 and April 15. The inshore boats carry two or three persons and make local day trips. According to Acheson et al. (1980), scallops are shucked on board the vessels and the shells are discarded at sea. A recent photo-essay (Mutch 1992) on a typical inshore ME scallop boat shows onboard shucking. ME scallopers that were interviewed in October 1992 only shucked at sea. On the other hand, there are some shell stockers in ME as was evident from the 1989 hearings on Amendment #4.

ME also has a few full-time offshore scallopers, who not only work state waters but also distant grounds ranging beyond Cape Cod and Canada. There were ten such vessels in 1978 (Acheson et al. 1980). At present, there are several more. Rockland, ME had three large scallop draggers in 1978. In October 1992, two large bow-rigged draggers (different vessels from those in 1978) were in the process of re-rigging for scallops rather than groundfish. Besides these two, Rockland only had a few small scallop boats. An offshore scalloper from Stonington, however, reported that there are ten to twelve boats, state-wide, that fish offshore. NMFS statistics show a total of 21 boats greater than 45 feet that have scallop permits and that landed more than 400 pounds of scallops during 1988-1990.

NH had one large wooden scalloper in 1978 (Acheson et al. 1980), docking at Portsmouth. According to NMFS statistics, there are no scallopers in the state presently.

MA has a mixed inshore and offshore fleet. The major part of the inshore fleet is located at Chatham, on Cape Cod. There are about 90 vessels between 25-50' long. A few inshore scallop boats were located in Provincetown in the late 1970s (Ono Husing, pers. comm., November 1992), but it is unknown whether they are still there.

The offshore fleet in MA consists of bow-rigged or "Eastern-rigged" draggers (generally older, smaller boats) and big steel-hulled stern-rigged or "Western-rigged" boats built specifically for scalloping. According to NMFS statistics, the vast majority of the boats are larger than 70 feet, with 22 over 100 feet. The largest permit-holding boat in the U.S., that

landed scallops in 1990, is 119 feet. MA boats are larger on average than those from other States (Table 26).

RI and CT have a few scallop boats. Some are smaller boats (70' or less), but few fish inshore. Two large scallop boats list New York City as their principle port. There are apparently no boats on Long Island. NC boats unload catches in Greenport, Long Island, but local scalloping is entirely confined to bay scallops (Matthiessen 1986).

There are two smaller boats that list PA as their principle port, and there are two smaller boats and one larger one in MD, but DE apparently has none.

NJ also has a fleet of "smaller draggers," primarily 50 to 75 feet "shrimper type" wood hull boats. There are about 25 scallopers from Point Pleasant, and perhaps 20 from Belford. These boats usually make day trips and short trips compared to the large trawlers in Cape May. Most NJ boats are, however, quite large. The average size vessel is larger than the typical VA and NC vessel, though not quite as large as the typical MA scalloper.

In the Mid-Atlantic area, there are a few small boats, but insofar as is known, all of the scallop vessels from VA and NC work offshore. The largest VA boats are nearly as big as those in MA. NC has a fair number of big boats, but none larger than 90 feet (Table 26).

Boats from the Gulf States occasionally fish for sea scallops. Landings by four FL boats and one MS boat appear in the 1990 statistics. In 1988 and 1989, there are also scallop landings by boats from TX and GA.

Most new boats in the scallop fleet are stern-rigged, but one 95 feet Eastern-rigged vessel was under construction in NJ during 1988 (Chowning 1988).

3. Processing sector

The processing sector hasn't changed significantly since implementation of the Atlantic Sea Scallop FMP. Industry practices before fishery regulation under the meat count standard is described in its Environmental Impact Statement (NEFMC 1982). Sutinen et al. (1992) described the scallop processing sector as well, and summarized the new elements which have developed in this sector. Although there are a significant number of independent vessel operators, several firms are vertically integrated. These firms own boats and shore-side facilities, and have distribution channels and retail outlets within the company.

Limited freezing at sea has developed since the EIS was prepared. Increases in this form of processing may have been hampered by the meat count regulations. According to Sutinen et al. (1992), breaded, fresh, and frozen processed products are the principal forms. Some Mid-Atlantic processors began to sell roe-on scallop meats in 1990. As of 1989, 31

processors marketed fresh, raw scallop meats; 19 produced frozen raw meats; twelve produced frozen breaded meats; two produced fresh or unfrozen breaded meats; and one produced cured scallops. Only two plants processed frozen raw scallop without handling other seafoods beside scallops. Limited recent efforts have been undertaken to collect data on this sector, and information about processing, distribution, and marketing may be seriously inaccurate.

The work routine to process scallops onboard vessels, especially big boats, is grueling. There are very few published descriptions of the work patterns (Dewar 1983, DuPaul et al. 1990). Pollack (1991a), writing about New Bedford boats, describes tows of 30 to 40 minutes, requiring the crew to work in continuous six-hour shifts.
There are two routine methods of handling scallops onboard the vessel. They are either shucked at sea or they are kept in the shell and brought to shore for processing. Landings scallops in the shell is referred to as "shell stocking". Most inshore ME boats, like nearly all offshore New England vessels, shuck at sea. Shucking scallops at sea may enhance available habitat for spatfall, although this has not been proven. This method is also preferred because of environmental restrictions on the shore-side disposal of shell. The disadvantage of shucking at sea is that it is labor intensive and requires boats to carry relatively large crews.

a. At-sea processing

Scallop processing begins on the boat when scallops are sorted from by-catch on deck. DuPaul et al. (1990) provided a detailed evaluation of at-sea handling processes aboard scallop vessels. Most of the landed scallops are shucked at sea. During this process, adductor muscle (scallop meat) is shucked from the larger scallops. The remaining shell and viscera as well as undersized scallops are discarded overboard. There is no legal limit on the size of scallop that may be shucked, but fishermen decide on the size of scallops to shuck to comply with the meat count standard which changes seasonally with scallop yield. Selection of large scallops minimizes the shucking time that might otherwise be used to process scallops from the next tow.

Scallop meats are packed in approximate 40 pound bags until they reach a dealer or processor. Many fishermen soak their scallops in fresh water or iced seawater. Soaking, which causes scallop meats to absorb water and become heavier, has become more prevalent since the adoption of a meat count standard in 1982. Soaking probably has enabled smaller scallops to be landed under the meat count regulation as fishing mortality rose and older scallops became more scarce. However, soaking is not entirely caused by the meat count regulation. It has the added benefit of increasing the total weight of landings. Some processors are reported to soak their scallops dock-side to further increase gross scallop weight and improve profit margins.

Another practice that has become more prevalent is mixing scallop meats. Enforcement of the current meat count regulations requires samples to be taken from several bags of scallops onboard a vessel. Since certain areas may produce small scallops, and those bags might be chosen to determine compliance with the meat count, fishermen often mix larger with smaller scallops before packing the meats in 40 pound bags. Mixing subjects the scallops to additional handling and possible thermal degradation (Sutinen et al. 1992). It is also common to find the proportion of pieces in landed scallops to be as high as ten percent, whereas a three percent proportion is an accepted standard from other sources. Sutinen et al. (1992) conclude, "Clearly, the regulatory meat count restriction has changed the practices of handling scallop which result in an overall poorer quality landed scallop."

Some boats freeze their catch onboard. The further development of freezing at sea may be hampered by the meat count regulation. New boats are highly mechanized. Many must lift and dump dredges with a couple of lines, but some boats now have automatic hydraulic dumpers aboard vessels that shuck at sea. Processors report that 500 bags can be unloaded in 27 minutes by eight men lifting the bags and putting them on conveyor belts.

b. Shell stocking

Shell stocking is practiced by a few inshore MA boats and a few large shell-stocking boats in New Bedford. Nonetheless, it is known as a typical practice of southern boats (Pollack 1989). NC vessels, in particular, formerly relied almost exclusively on shell stocking due to relatively low labor costs on shore and because the boats were not built to carry as many crewmen as needed for shucking at sea. There may still be a significant amount of shell stocking in the Pamlico area.

Shell stocking is typically associated with boats that fish for scallops with nets rather than dredges. There are, however, a few dredge boats that land shell stock. There are also companies whose boats formerly shell stocked that are now shucking at sea. Shell stocking also occurred in NJ. Levine and McCay (1987) note that shell stocking and shucking were about equal in frequency in NJ during the mid-1970s, but shell stocking disappeared by a decade later. More details on the distribution of the two processing methods are found in the FMP (NEMFC 1982).

Under the meat count regulations that have been in effect in recent years, there has been some incentive for vessels to shell stock rather than shuck at sea. This occurs because the boats that shell stock are subject to shell height requirements instead of the meat count. Shell heights are easier to accurately measure as the catch is brought in. There is a tendency, however, to shift from shell stocking to shucking to improve quality of and prices for the catch.

Very little onboard processing occurs on vessels that shell stock. Generally, shell stock trips are shorter due to limited storage life. Once shucked, the shell stock is handled in the same manner as scallops that are landed shucked.

c. Shore-side

Three product forms described in the 1982 EIS (NEFMC 1982), breaded, fresh, and frozen remain the major product forms (Sutinen et al. 1992). Some processors in the Mid-Atlantic began to sell roe-on scallop meats in 1990, but the practice is limited. Forty-eight plants processed sea scallop in 1989; 31 produced fresh scallop, 19 produced fresh-frozen scallop, 12 produced frozen breaded product, 2 produced fresh or unfrozen breaded product, and 1 produced cured product. Only 2 plants which handle frozen scallop processed only sea scallops and no other fish or shellfish. Unfortunately, detailed data concerning the processing and marketing sectors is lacking.

4. Marketing sector

Figure 10 shows the volume of imports of sea scallops from 1978 to 1988 from Canada and

all other countries. Exports of scallops are negligible. The above product forms, both domestic and imported, are marketed within the U.S at wholesale to processors, brokers, restaurants, and retail markets. Market demand and value-added mark-ups are unknown. In part due to the meat count regulation, imports fill a void in the market for low cost, frozen alternatives to the higher priced and larger domestic scallop. These small scallops may also be competing in some markets with the calico (Argopecten gibbus) and the bay scallop (Aequipecten irradians), the latter being a much higher priced alternative. Several studies (Altobello et al. 1977, Wang et al. 1986, and DuPaul et al. 1989b) found that some imported scallops serve as suitable substitutes to domestically landed scallops.

Domestic consumption of sea scallops appears to fluctuate with supply and to be limited by resource conditions. Per capita consumption of sea scallops ranges from below 0.1 to as high as 0.25 pounds. It represents only a small portion of U.S. seafood consumption, which has been rising steadily since 1967 (Figure 11). Consumption seems to be elastic and is inversely related to price. It also appears to be positively related to income (Wang et al. 1986, Edwards 1981).

E. Effects of Fishing

1. Habitat

Scallop dredging causes substantial physical disturbance to the environment since the dredges are designed to scrape the sea floor. Actual studies of this type of gear and the potential damage it can cause are, however, limited in number and most of them are fairly recent publications. ICES documents by the study group on ecosystem effects of fishing activities (1991, 1992) reported that scallop dredges have been shown to re-suspend fine sediments, plough gravel and stone, and even displace boulders (see Caddy 1973; Chapman et al. 1977) as well as cause mortality to scallops themselves and other benthic organisms.

Dredging impacts and dredge efficiency in the scallop fishery were first studied in situ by Caddy (1968, 1970, 1973) via scuba and submersible observations on several Canadian scallop beds. Caddy (1968) noted that dredging resulted in dis-lodgement of buried shell material or burying of gravel under re-suspended sand as well as overturning of larger rocks with an appreciable roughening of the sediment surface. An aggregation of fish and predatory invertebrates in the dredge track immediately after fishing was also observed.

2. Marine sanctuaries

The only National Marine Sanctuary which is established or is under consideration within the managment unit is Stellwagen Bank. The designation of this sanctuary does not restrict commercial fishing and is intended to protect and enhance sanctuary resources. Very little scalloping occurs in this area located 30 nm from Boston Harbor. To the extent that the

proposed action is expected to conserve scallop and fish stocks, the impacts are expected to be positive and consistent with sanctuary objectives.

3. Associated species and by-catch

In more recent work, Mayer et al. (1991) examined the impact of dredging on the sediment biogeochemistry while Langton and Robinson (1990) made some rather opportunistic observations on scallops and associated fauna before and after their study site was extensively dredged. Mayer et al. (1991) concluded that dredging caused an immediate net downward shift in the organic matter with a potential corresponding functional change from mixed metazoan-microbial aerobic to a microbial dominated, anaerobic metabolism. In an ecological sense this represents a potential food chain shift away from a direct fish-benthos connection if the sediment characteristics remained as observed one day after dredging. Langton and Robinson (1990) studied faunal associations on a scallop ground and found a decrease in the density of the three major megafaunal species following dredging of the study site. Not only was the scallop density reduced by 70%, but two other sessile invertebrates, a mud burrowing anemone and myxicolid worm, showed a significant population decline of 25% to 27%.

4. Discard and gear mortality on scallops

Dredge damage to scallops remaining after the area has been fished has been the focus of several research projects. Caddy (1973) observed broken and mutilated shells in the dredge path and estimated incidental dredge mortality to be in the range of 13 to 17%. Murawski and Serchuk (1989) also made submersible observations of dredge tracks and found a much lower mortality rate, in the range of <5%. The difference in mortality between these two studies can be attributed to the substrate on which the experiments were conducted. Caddy's work was done in a sandy / gravelly area and Murawski and Serchuk worked on a smooth sand bottom. Shepard and Auster (1991) investigated the effect of different substrate types on dredge induced damage to scallops and found a significantly higher incidental damage on rock than sand, 25.5% vs 7.7%.

Survivorship of undersized scallops culled overboard was evaluated by Murawski and Serchuk (1989). In several controlled experiments it was found that culling mortality for undersized scallops was probably no higher than 10%, at least over the short term (1-3 days) of the experiment. Gruffydd (1972) suggested that sand packing in scallop shells may injure the mantle tissues and perhaps cause significant mortality. Such mortality might not be immediately apparent. Shepard and Auster (1991) also discussed survivorship and pointed out that there may be substantial differences between mortality rates for very young scallops and older, legal sized, scallops. On the one hand, smaller scallops are more active and can potentially swim out of the way of an oncoming dredge (see Caddy 1968), but the youngest animals (spat) are attached to the substrate by byssal threads and would

be extremely susceptible to dredging activity.

Although otter trawls are only used about 6 to 7% of the time to fish for sea scallops, their impact may be important to the fishery in southern areas. In a comparison between scallop fishing by double-rigged trawler vessel and a double-rigged dredge vessel, Kirkley (1986) found that the trawl gear harvested more scallops per tow than the dredge gear (55 lb / min vs 24 lb / min) and a higher percentage of scallops smaller than 80 mm (38% vs 25%). A higher mortality of small scallops on board trawlers was also evident. Whereas on dredging vessels scallops too small for shucking are discarded, they are customarily retained on trawling vessels for shell stocking. Substantial damage to these scallops occurred due to the crew members walking through the pile of scallops and also due to subsequent emptying of scallops from each tow.

Scallop beds and the benthic community associated with scallop fishing grounds in the Bay of Fundy was assessed in 1969 (Caddy 1976; Caddy and Carter 1984). During the intervening years the area has seen great changes in fishing pressure. Recently over 90 vessels of over 25 GRT were continuously fishing the grounds with Digby drags for days at a time (Kenchington and Lundy 1991). Since 1969, there have also been dramatic fluctuations in scallop abundance, including both record highs and lows for this century. In particular, scallop abundance rose to over 1000 times "normal" levels with the recruitment of two strong year classes in 1985 and 1986. With increased fishing pressure, and a mass mortality of the animals in the summer of 1989, abundances of scallops are currently at more normal levels for the area. Although this is anecdotal information, it does indicate that extensive dredging does not impact the recruitment of scallops to a productive ground.

F. Anthropogenic Impacts on Scallops

Larger scale physical features and oceanographic phenomena, as described in the section on the physical oceanography of the northwest Atlantic, have dominated research programs in recent years. There is a growing awareness that a different, finer biological, scale of resolution is needed in these research efforts. Knowledge of the factors controlling events at the level of specific scallop grounds is necessary to develop management strategies that will sustain the resource. The change in life history from pelagic larvae to benthic juvenile and adults represents a shift from control by large scale oceanographic features to the finer scale of resolution represented by the scallop grounds themselves. It is at this finer scale where anthropogenically produced perturbations of the environment may have their most significant impact. The environment which would be affected by proposed Amendment #4 is subject to a variety of anthropogenic impacts. The major types of environmental influences are described below.

1. Impact of contaminants and ocean disposal activities

a. Trace metals

Barged wastes are considered to be the dominant offshore source of any high concentrations of anthropogenic metals (Pesch et al. 1977). Municipal waste water discharges are also responsible for much heavy metal contamination. Since bivalves store trace metals and other anthropogenic chemicals efficiently, researchers have, over the past decade, used bivalves for indicators of pollution.

The areal distribution of the concentrations of 13 metals in sea scallop tissues were examined in the vicinity of two ocean disposal sites in 1977 (Pesch et al. 1977). The first dump site was located 65 km southeast of Delaware Bay, where for 9 years E.I. Dupont de Nemours Co. dumped acid wastes from a titanium dioxide plant located at Edge Moor, DE. The second site was located 9 km southeast of the first, where the city of Philadelphia disposed of sewage sludge from secondary treatment for 4 years. The acid wastes contained titanium, vanadium, manganese and iron. The sewage sludge contained copper, silver, lead, nickel and cadmium. Patterns of elevated concentrations of silver, copper and nickel were found in sea scallops within the confines of the Philadelphia sewage sludge. Vanadium, a tag for Dupont acid waste, was highest in scallops collected just downstream (south) of the acid waste dump-site (Pesch et al. 1977; Reynolds 1979).

Cadmium: Elevated levels of cadmium in bottom waters may be the result of natural or anthropogenic causes. In some areas, cadmium levels are higher in bottom waters than at the surface due to the natural decay of organisms (Coombs 1979). In other areas, elevated cadmium levels are due to contaminants in wastes dumped at sea.

Some researchers consider cadmium to be the most serious metallic contaminant man has to deal with in the latter part of the twentieth century (Goldberg 1984). Scallops concentrate cadmium more efficiently than other bivalves (Palmer and Rand 1977) in the gonad and adductor muscle, (both of which are marketable), as well as the kidney, digestive gland, and gills (Yevich and Yevich 1985). Gould (1983) reported unusually high cadmium concentrations in the kidneys of sea scallops collected just south of the Hudson Canyon, downstream from dump-sites in the Christiaensen Basin. High cadmium levels in the kidneys have also been observed in deep-water sea scallops in the Gulf of Maine (Gould 1983) and in a populations off Asbury Park, NJ (B.A. Fowler unpub. data - quoted from Gould and Fowler 1991).

High cadmium levels have been found in sea scallops from Georges Bank and Browns Bay south of Nova Scotia. Researchers suggest that these elevated levels may be due to a natural source of cadmium (Ray and Jerome 1987), since levels of other metals are not elevated (Ray et al. 1984). Uthe and Chou (1987) have also raised the possibility that high

cadmium levels in these scallops may be due to nutritional deficiencies. Greig et al. (1978) also found sea scallops with high cadmium levels at two sites near the outer shelves of the Hudson Canyon.

Studies on the effects of cadmium in sea scallops have been conducted by Gould and co-workers (Gould et al. 1985a,b; Fowler et al. 1985; Fowler and Gould 1988). Scallops exposed to sublethal concentrations of cadmium (10 and 20 ppb) accumulated the metal in their kidneys and gonads, but no damage to the tissues of these organs occurred (Gould et al. 1985b; Yevich and Yevich 1985). Instead, cadmium induced hormetic effects: early gonad maturation, early spawning and early removal of glycogen from the adductor muscle (Gould et al. 1985a, Fowler and Gould 1988). Cadmium is then held tightly in the adductor muscle (Chou et al. 1978), the marketable part of the scallop.

Copper: The effects of copper on sea scallops has been studied in conjunction with cadmium research. Copper is very toxic to the functioning of the kidney (Gould et al. 1985b, Fowler at al. 1985; Fowler and Gould 1988). In histopathological studies of sea scallops, Yevich and Yevich (1985) found that the kidneys of copper-exposed scallops are very dilated with loss of folds. These researchers suggested that the lesions of the kidneys, considered irreversible, could have caused death of the scallops due to renal failure. Gould et al. (1985a) reported seasonal differences in toxicity tolerance levels. Scallops were found to be more susceptible to copper in winter when the animal was in the early stage of gametogenesis than in spring, when they had fully differentiated gonads. When scallops were exposed to a mixture of equimolar concentrations of copper and cadmium, the toxic effects of the copper predominated in both kidney and gonad (Gould et al. 1988b).

Gould and Fowler (1991) have speculated that in coastal areas of the northern range of the sea scallop, such as the Gulf of Maine, poor recruitment might be expected for populations near waste-water outfalls or dump-sites, in which copper is a chronic metal pollutant. It is also possible, however, that these inshore sea scallop populations may have developed some measure of tolerance in regulating overloads of copper, as is apparently the case with cadmium. Such a development could be effected by chronic induction of metal-sequestering mechanisms over the lifespan of the sea scallop.

Because of their affinity for uptake of trace metals, sea scallops are readily contaminated in areas of ocean dumping making their marketable meats and gonads unacceptable for human consumption. Contamination of scallop beds by trace metals can cause adult scallop mortality and can affect the reproductive physiology of sea scallops, thus increasing the probability of poor recruitment.

b. Oil pollution

Boehm et al. (1979) reported on the ubiquity of anthropogenic petroleum hydrocarbons on

Georges Bank, Nantucket Shoals and the lower Gulf of Maine, introduced by chronic inputs from bilge pumping and normal shipping traffic, and from the ARGO MERCHANT oil spill in 1976. Although the input of petroleum hydrocarbons to the benthic environment was sizable, the chemical impact on scallops was short lived. Scallops collected from the site of the ARGO MERCHANT accident three weeks after the oil spill showed depressed gill respiration compared to scallops from nearby uncontaminated areas, but had normal respiration six weeks later (Thurberg et al. 1978).

Hydrocarbons may accumulate in the tissues, including the marketable meat of scallops, as reported from the site of the ARROW oil spill (Scarratt and Zitko 1972) and the barge OCEAN 250 gasoline spill (Griswold 1981).

There is no evidence that oil pollution causes long-term effects on sea scallop stocks.

c. Polynuclear aromatic and halogenated hydrocarbons

Risebrough and Vreeland (1972) reported that aerial transport appears to be the main route of entry of PCB's into the offshore marine environment. Analysis of the adductor muscle of sea scallops collected from the New York Bight show that the area is measurably and significantly contaminated by polynuclear aromatic hydrocarbons (Humason and Gadbois 1982). There are no published reports on the effect of these contaminants on scallop stocks or recruitment.

d. Industrial wastes

In the Northeast, three sites have been heavily used for the dumping of industrial wastes in coastal waters. Probably other non-designated sites were also used. Three sites were specifically designated to receive industrial waste: 1) the Industrial Waste Site, located approximately 19 nautical miles off Boston; 2) the New York Bight Acid Waste Site, located off NY near the 12-Mile Sludge Dump Site; and 3) the 106-Mile Deepwater Industrial Waste Site, located about 105 nautical miles off Atlantic City, NJ.

Industrial Waste Site (IWS): Massachusetts Bay, off Boston, has been used for nearly 100 years for the dumping of industrial and commercial wastes. The principal disposal area within Massachusetts Bay was the IWS, a circular area with a radius of 1 nm with the center located at 42°27.7' N and 70°35.0' W. It is in approximately 90 meters of water and located around 19 nm from Boston Harbor.

While records are incomplete or unavailable, it is clear that a wide variety of waste materials were disposed at the IWS. Among the materials dumped there were low level radioactive wastes (LLW) as well as toxic and hazardous chemicals. According to a review by Wiley et al. (1992), roughly 4,000 containers of LLW were dumped in Massachusetts Bay

at four designated sites between 1953 and 1959, principally within or near the IWS. Some defense-related LLW may have been deposited as early as 1946. Its resting place is unknown. Much of the material dumped in the late 1950's was encased in reinforced concrete. Unfortunately, not all the material dumped in the earlier years was protected in this fashion. Even then, many years of salt water exposure has the potential to cause corrosion and leaking of the contents.

The other major class of materials disposed at the IWS was toxic and hazardous wastes. These were generally held in 55 gallon drums, many of which were either mechanically punctured or pierced with firearms during the disposal operation. These methods were used to insure that the barrels sank and the materials inside would be dispersed and diluted. While specific records of the methods of disposal are virtually non-existent, the available cargo manifests list materials that are believed to have carcinogenic, mutagenic, neoplastic, or teterogenic effects. Compounds containing heavy metals and halogenated organic compounds are also included on the manifests. The full nature of the toxic materials dumped is unknown. Wiley et al. (1992) estimated, based on intensive side-scan sonar and remotely operated vehicle surveys, that approximately 21,000 containers are present in or near the IWS. In addition, based on some records and eyewitness accounts, it is likely that many more containers were dumped nearby outside the IWS perimeter. Dumping at the IWS ceased around 1976. The site was de-designated by the EPA in the early 1980's.

The "Foul Area" IWS is heavily fished by bottom trawlers and fixed-gear fishermen. Despite a 1971 FDA advisory against fishing in this area, commercial fisheries primarily on groundfish within the 10-minute statistical area continue. Over 6 million pounds of fish were harvested from the area in 1982-1984. Commercial scalloping, however, rarely occurs within this zone (NMFS 1990).

New York Bight Acid Waste Site: The Acid Waste Site (40◦16' to 40◦20' N and 73◦36' to 73◦40' W) was established in 1948 for the disposal of acid and alkaline wastes generated by the industries of NY and NJ. The site received interim designation by the EPA in 1973, and was last used in 1988. EPA has determined that effects from this dumping were localized and transient (EPA 1980), and that no long-term effects are likely as a result of past discharges at the site. Therefore, no monitoring has been terminated.

106-Mile Deepwater Industrial Waste Site: The 106-Mile Industrial Waste Site was designated within the larger 106-Mile Sludge Site in order to allow effects of sludge dumping and the discharge of industrial waste to be monitored. The Site is circular with a radius of 3 nm centered at 38°45' N and 72°20' W, located approximately 125 nautical miles southeast of Ambrose Light, NY. No dumping currently occurs at the site and de-designation is expected.

Between 1961 to 1978, approximately 5.1 million metric tons of liquid chemical waste were dumped at the 106-Mile Site, in addition to approximately 380,000 metric tons of sludge and other municipal wastewater residues.

Like the Acid Waste Site, the EPA (1980) has determined that no lasting effects will be seen from the use of this site, and therefore, continued monitoring is unnecessary. However, the nearby 106-Mile Sludge Site was extensively monitored pursuant to provisions of the Ocean Dumping Ban Act of 1988, under the auspices of the 106-Mile Site Monitoring, Research, and Surveillance Program. Living marine resources were a principal focus of this monitoring effort.

EPA (1989) indicates that commercially important species are not generally caught within the 106-Mile Dump Site, but the general area, the Middle Atlantic Bight, supports commercially important fisheries of yellowtail flounder, red hake, Atlantic mackerel, spiny dogfish, tilefish, and shellfish (lobster, red crab, and scallops). The study further mentions that landings indicate a downward trend for yellowfin, silver hake, and haddock.

Impacts on the scallop resource:

Of these sites, only the latter may have had a significant impact on the scallop resource. The Industrial Waste Site and the New York Bight Acid Waste Site are sufficiently inshore of known fishable concentrations of scallops so that their impacts are expected to be negligible. There are, however, occasional concentrations of sea scallops on Jeffreys Ledge. This site, if significant industrial dumping occurred near shore to the north of Cape Ann, MA, would be negatively impacted.

As mentioned previously, given that much of this waste material was simply discharged into open ocean waters, it was believed dilution and dispersion would insure that the impacts to living marine resources were minimal (EPA 1980). Such a belief guided the decision making of federal agencies, but greater public concern about the containerized waste, such as that disposed of at the IWS in Massachusetts Bay, has resulted in the initiation of new monitoring efforts to allow a better understanding of the long-term effects of this discharge of contaminants into the marine environment.

The additive and synergistic effects of the disposal of these contaminants, adding to the many other point and non-point sources such contaminants into the coastal oceans, have not been identified.

2. Effects of nutrient loading

In the past 20 years nutrient loading and subsequent eutrophication has increased significantly in coastal waters, primarily due to sewage and industrial waste contamination. The nitrates in acid rain may also contribute to over-enrichment. The problem of nutrient loading is most serious in waters near highly urbanized and high-intensity agricultural areas. Nutrient loading is evidenced by high concentrations of nitrogen and phosphorus and recurring phytoplankton blooms.

Dissolved oxygen: In a review of oxygen depletion and eutrophication in coastal waters conducted during the mid-1980's, Whitledge (1985) and coworkers found that episodes of low concentrations of dissolved oxygen (DO) were chronic in Boston Harbor due to nutrient loading from municipal and combined sewers. The only area on the open continental shelf of the eastern United States affected by recurring hypoxia were coastal waters of the New York Bight.

In the summer of 1976, 10% of the sea scallop populations in an area of the Mid-Atlantic Bight off the coast of NJ were lost due to oxygen depletion of bottom waters (Ropes et al. 1979). The area involved lies downstream from the Hudson River-Raritan Bay Efflux, and contains the largest known marine shellfish stocks of any comparable coastal area in North America (Steimle and Sinderman 1978). Although oxygen depletion of bottom waters can occur naturally, this hypoxic event was considered largely anthropogenic (Sinderman 1979). Early warming of the surface waters and subsequently an early thermocline, plus a massive and persistent phytoplankton bloom within 100 km of the coast superimposed on an area stressed by sewage and industrial contaminants, was held to have caused the hypoxia (Gould and Fowler 1991). Large phytoplankton blooms are becoming an annual reality in sections of the New York Bight due to organic loading (Steimle and Sinderman 1978).

Episodes of hypoxia have not been reported in the offshore bottom waters of the Gulf of Maine or on Georges Bank. However, eutrophication problems have begun to occur in localized coastal waters. Loder and Becker (1989) suggested that these may be the first warning signs that parts of the system are being stretched beyond their normal assimilation capacity in terms of nutrients. They noted that the problems will only get worse if steps are not taken to set control practices in place. In 1995, sewage from Boston Harbor is scheduled to be redirected to an offshore effluent outfall (MWRA 1991). There is concern that coastal waters near densely populated areas, such as Cape Ann, Cape Cod and Stellwagen Bank will be adversely affected by this operation.

Dinoflagellate toxicity: Paralytic shellfish poisoning (PSP) caused by the dinoflagellate phytoplankter, Alexandrium tamarense, was originally a localized problem primarily in the northern part of the Gulf of Maine. However, over the past 25 years, high PSP levels have

spread southward along the entire coast of ME and into NH and MA. There is a strong association between blooms of A. tamarense, PSP toxicity and the plume of relatively brackish stratified waters forming in the western Gulf of Maine in the spring (Franks and Anderson 1992a,b). It is not clear, however, whether the enrichment of this inshore water is due to natural or anthropogenic causes.

The commercial importance for the scallop adductor muscle (meats) and the continued interest in establishing a market for the roe and mantle tissues have generated recent interest in toxicity levels in scallops caused by dinoflagellates. Adductor muscles do not sequester toxins and are sent to market regardless of the toxicity level of the other body parts (Jamieson and Chandler 1983; Prakash et al. 1971; Shumway, unpublished). Shimuzu and Yoshioka (1981) showed that extracts of adductor muscles from sea scallops effectively deactivated the toxins. This ability is apparently limited to the locomotor tissue. Toxicity levels vary between tissues and between seasons and locations. Bourne (1964b) found little or no toxin in scallops from Georges Bank and southern Gulf of St. Lawrence. Animals from the Bay of Fundy had poison-free adductor muscles and gills, but toxic digestive glands and mantle tissue that persisted throughout the year. Gonad tissue was also found to be occasionally slightly toxic. Prakash et al. (1971) demonstrated that the digestive glands contained most of the poison and that mantle tissue is a secondary site. Reported toxin levels in the gills are generally high (Medcof et al. 1947; Shumway, unpublished).

3. Effects of mining operations

Much of the research on the effects of ocean mining on sea scallops stems from exploratory drilling for oil. Although those drilling operations have ceased in the northwest Atlantic, a review of the potential effects are included here in the event that drilling for oil would be considered in the future and because much of the research also applies to ocean mining for the extraction of marine sediments. The potential for sediment extraction is substantial in waters off the U.S. east coast.

a. Oil drilling

Chemical drilling fluids or "muds" used in exploratory mining operations adversely affect sea scallops. By exposing sea scallops to separate mud components, synthetic muds and used muds, researchers have observed detrimental effects of drilling muds on the development of scallop larvae and on gill and kidney function in adult stages. Gilbert (1981) reported a significant inhibition of shell formation in 2-day sea scallop larvae exposed to high concentrations of the liquid phase of a mixture of used chrome lignosulfonate.

McLeod et al. (1979) reported that mud loading on sea scallop gills led to an increased filtration rate and mucous cell proliferation and production. As a result, energy stores

eventually declined with an attending decline in the rates of these functions. The clay, attapulgite, alone or when in mixed components, was more stressful than the clay, bentonite, and the effects were greater at higher temperatures. Morse et al. (1982) studied the sublethal effects of attapulgite and the anti-viscosity additive Q-broxin (ferrochrome lignosulfate) on the gill morphology of sea scallops. They demonstrated that there was a slight unzipping of the gill filaments when the scallops were exposed to 500 ppm of the mud components. Increased damage occurred as the time of exposure increased. When exposed to 1000 ppm, fraying and tearing of the gill occurred.

The trace elements, chromium and barium, contained in drilling fluids are taken up by sea scallops and stored primarily in the kidney. In laboratory studies by Liss et al. (1980) and McLeod et al. (1979), the levels of these elements remained at the same levels or actually increased following a two week depuration period due to the cleansing of other tissues by the kidneys.

b. Sediment extraction

Sand and mixed aggregates, suitable for marine extraction, occur in Boston Harbor between Hull and Plymouth and a large bank of aggregates forms Stellwagen Bank. Beds of aggregates also occur in the Gulf of Maine particularly in waters off of Cape Ann, but these beds are small and in waters too deep to be mined easily at the present time.

Mining for marine sediments is accomplished by scraping the sediment surface or by suctioning the sediments on to a receiving barge. Stationary suction dredges create large "pits" or depressions many meters deep. Trailing suction dredges do not cause such pits, but leave shallow (0.2m) furrows 1 to 4 meters wide over a more extensive area (Messieh et al. 1991). The operation may be highly intense in a small area or less intense, but more widespread depending on the type of equipment used.

Ocean mining physically removes the existing benthic organisms and may completely destroy the existing ecosystem if the substrate composition is changed. Shelton and Rolfe (1972) described recolonization to a mined area on Hastings Shingle Bank (English Channel). The bottoms of the depressions were initially colonized by a muddy sand fauna that was replaced by a clean sand fauna as the finer fractions washed out. DeGroot (1979) documented that in an area where sand and gravel overlaid a rocky substrate, there was no redeposition of sediment after an experimental mining operation. Over time the previous soft bottom community was replaced by a hard bottom community on the exposed rock substrate.

Where pits are formed by the mining operations, there is usually little transport of gravel from other areas into the depressions. With the reduced strength of bottom currents within the pits, fine organic sediments are deposited into the depressions. The result is an increase

in organic enrichment and subsequent oxygen depletion.

Mining operations cause resuspension of fine sediments which adversely effect organisms in the surrounding waters and may also be carried long distances from the mining site to effect other areas. If screening of sediments is done at sea, the problem is magnified. When the resuspension of fine sediments is extreme it may adversely effect sea scallops in much the same way they are effected by oil drilling muds, by clogging of the gills and eventual suffocation of these filter feeders. Suspended sediments may have chronic sub-lethal effects on essential biological processes, such as feeding and respiration. Since sea scallop spat do not settle on fine sediments, the accumulation of fine sediment on the sea floor may decrease recruitment resulting in low population production.

When sediments are disturbed in inshore estuarine or deeper channels, there is the possibility for release of harmful chemicals from these sediments when surficial sediments are removed. The accumulation of trace metals by sea scallops and the effects of cadmium and copper on the physiology of the sea scallop were discussed previously in this document.

In summary, ocean mining can remove suitable substrate for sea scallop spat settlement, effect larval development and adversely effect the reproductive, respiratory and feeding physiology of adults. Although the effects may not be as severe in an open system, in a closed system like Georges Bank, the effects could be critical. Messieh et al. (1991) suggests that since the George Bank gyre could prevent the immigration of larvae from outside, the ability of sea scallop stocks to recover from perturbations may be limited. The authors point out further that strong vertical mixing increases the chances of particulate wastes and spilled oil and gas reaching the seabed.

4. Sewage sludge

a. Sludge dumping in the Gulf of Maine

Ocean dumping of sludge has not been permitted by the U.S. Environmental Protection Agency (US EPA) at any location in the Gulf of Maine. However, for decades sludge was discharged into the waters of Boston Harbor from the Deer Island and Nut Island Waste Water Treatment Plants. According to Massachusetts Water Resources Agency (1987), an average of 87 dry tons of anaerobically-digested sludge was discharged to Boston Harbor on a daily basis. This discharge was eliminated in December 1991. While the fate of this material was not definitively known, given that it was discharged only on the outgoing tide, it is presumed that the majority, although not all, was ultimately deposited in Massachusetts Bay and incorporated into the sediments. The quality of the sludge discharged was variable, but generally contained elevated concentrations of heavy metals and contaminants such as PAHs and PCBs. Given the multiple sources of such

contaminants, including discharge from combined sewer overflows and liquid wastewater effluents, atmospheric deposition, and ocean dumping of industrial wastes, among others, and because most scallop fishing in the Gulf of Maine occurs outside the Boston Harbor area, the impacts to any scallops in the Massachusetts Bay/Cape Cod Bay system is probably minimal.

b. Sludge dumping in the Middle Atlantic Bight

South of Cape Cod, most ocean dumping of sewage sludge occurred at a site 12 miles off Sandy Hook, NJ, in the northern NY Bight. From 1924 until 1987 when the site was closed, it was used by up to 200 sewage treatment plants, and though the number of municipalities using this site decreased over time, the volume of sludge increased as facilities improved (Environmental Processes Division 1988). Since 1960, when dumping rates were recorded, there had been a general increase reaching a maximum annual amount of 7.6 million metric tons (wet weight) in 1983 (Suskowski and Santoro 1986). Sludge inputs in the early 1980s were, at the time, the largest known to any oceanic sludge dumpsite (Norton and Champ 1989). Composition of the sludge changed over time as improved sewage treatment and lowered industrial inputs reduced contaminant concentrations. A comparison of 1973 and 1987 loadings indicated decreases in total sludge solids, biochemical oxygen demand and most heavy metals; for example, amounts of cadmium, chromium and mercury were reduced by at least 45% over the 14-yr period (HydroQual, Inc. 1989; Reid et al., in review). Estimated annual pollutant loadings to the New York Bight apex from sewage sludge and other major sources (ca. 1980) are given in Stanford and Young (1988).

Considerable effort has gone toward determining fates and effects of the dumped sewage sludge (e.g., Gross 1976a,b; Mayer 1982). However, determination of fates and effects had been confounded by the other waste inputs in the area. Sludge disposal had ranked only third in loadings of organic carbon and most contaminants to the inner Bight; dredged material ranked first and the Hudson-Raritan outflow second (Stanford and Young 1988). The phase-out of sludge dumping in the inner Bight between March 1986 and December 1987 prompted a multidisciplinary study by NMFS and collaborators to examine ecosystem responses and thus infer what the fates and effects of the sludge had been (Environmental Processes Division 1988). The study included monthly sampling of a large suite of physical, chemical and biological variables from July 1986 through September 1989. During the study 991 otter trawls were made at 25 stations covering an area of 100 sq km. Abundance and composition were recorded for 75 species, representing 46 families of fish and megainvertebrates.

Responses of benthic macrofauna to cessation of sludge dumping were somewhat greater than changes in fish diets, but were still limited (Reid et al. in review). The area which had been thought to represent greatest sludge accumulation and effects had been dominated by *Capitella* spp. and nemerteans (ribbon worms), and had fewer overall species than found in

other parts of the Bight apex. After cessation, total numbers of species increased significantly relative to numbers at other sites sampled, as did numbers of species of molluscs, crustaceans and amphipods. As noted, there were significant decreases in abundances of *Capitella* spp. and ribbon worms. However, 34 and 39 months after cessation of dumping there was little evidence of colonization of the sludge-affected area by species that were dominant at the other sites.

During a study of demersal fish (including winter flounder and spot, *Leiostomus xanthurus*) in estuaries between Chesapeake Bay and Frenchman's Bay, ME as part of the National Status and Trends Program, Zdanowicz and Gadbois (1990) demonstrated increased concentrations of synthetic organic contaminants in stomach contents relative to sediment and a further increase in liver tissue concentrations relative to the stomach contents. Similar processes related to bioaccumulation also appear to have occurred at the 12-mile dumpsite. Sediments near the 12-mile site are contaminated with organic compounds (PCBs, PAHs and chlorinated pesticides) as well as trace metals such as Pb, Cu, Zn, Hg, Cd, and Cr (Boehm 1982; Zdanowicz 1982; 1991; Deshpande and Powell, in review). Concentrations of these sewage derived materials generally decrease with distance from the center of the dumpsite except that depositional areas to the west in the Hudson Shelf Valley tend to be more contaminated than shallower, sandy sites located similar distances to the east. Lobster and winter flounder from the 12-mile dumpsite were found to have higher levels of PCBs than animals from adjacent reference areas (Draxler et al. 1991). Uptake of contaminants for both prey and predators may result directly from exposure to water and/or sediment or from transfer up the food chain, which is suggested by findings of elevated trace metal concentrations in the benthic prey of demersal fish in the dumpsite area (Steimle and Zdanowicz, pers. comm.).

Since trace metals Cu and Cd were found at elevated concentrations in bottom sediments, and scallops have been found to show anthropogenic affects from these metals, sewage dump site locations that overlap productive scallop habitat is problematic. In addition, since scallops are susceptible to adverse effects of suspended sediment, they are likely to be directly impacted by the dumping of sludge. Of those scallops that are not buried, it is likely that suspended material near and within a dump site will inhibit respiration and feeding.

c. Sludge dumping at the Philadelphia Site

Sewage sludge was also dumped at a site near the mouth of Delaware Bay between 1961 and 1973, and at the "Philadelphia Dumpsite", 70 km east of Ocean City, MD, from 1973 to 1980 (Devine and Simpson 1985). Since amounts dumped were much smaller than in the New York Bight (e. g., a maximum of about 700,000 metric tons/yr at the Philadelphia site), and the sites are peripheral to the distributions of the scallops, the effects are not considered.

5. Dredging and soil disposal

Population growth along with a wide variety of industrial developments dependent on water borne commerce creates a need for dredging and the associated disposal of dredged material. Because of the large number of navigable harbors, the amount of dredged material generated by harbor maintenance, and the relatively low expense of ocean disposal, open-water disposal is routinely utilized. Nationally, more than 65 percent of all dredged material is dumped in the ocean. Unfortunately, domestic and industrial waste disposal activities contaminate many of those sediments. As marine ecosystems became better understood, the effects of ocean disposal has become apparent. Ocean dumping of pollutants contributes to the declining health and abundance of living marine resource habitats.

a. Dredging

Dredging creates and maintains navigable waterways, turning basins, harbors and marinas. Dredging projects in the coastal zone are required for diverse purposes and cause various types of impacts. The major potential adverse environmental impacts are: (1) increased turbidity, (2) altered habitat, (3) disruption and direct removal of productive habitat and the life it contains (seagrass beds, shellfish beds, spawning areas, etc.), (4) disruption of natural water circulation patterns, and (5) release of large quantities of trapped nutrients, organic material, and toxic pollutants from the materials.

In the short-term these effects can affect marine organisms by clogging gills with silt; reducing light penetration; facilitating eutrophication; depleting dissolved oxygen; and by making heavy metals, pesticides, or other toxic substances bio-available. These pollutants can accumulate within tissue of marine organisms to unhealthy concentrations and contribute to long-term chronic or lethal effects. Also, some species (winter flounder, anadromous fish and other coastal dependent species) can be adversely impacted by excessive turbidity when dredging operations occur during periods of fish migrations and spawning. However, if dredging and disposal is curtailed during sensitive life stages, adverse impacts can often be avoided.

b. Ocean disposal

The disposal of dredged materials has important environmental effects beyond those associated with the actual dredging operation. The Corps of Engineers presently disposes of approximately 65 percent of its dredged material in open water. Land disposal offers the possibility of preventing adverse environmental impacts that cannot be controlled in open-water disposal. However, major drawbacks to land disposal include the difficulty of securing large tracts of land, access easements, polluted water runoff, saltwater intrusion

into ground waters, and costs of transporting materials to the selected site.

Because of these handicaps it is easy to see why open-water disposal is an attractive alternative. Disposal of polluted spoils, however, poses a significant threat to estuarine and open-water areas. Major pollution problems are generally associated with the highly organic, petrochemical-laden silts and clays mixed with domestic and industrial wastes of urban or industrial harbors.

Specifically, concerns with disposal of materials in the ocean can be summarized as follows:

(1) Contaminants found in industrial wastes, dredged materials and sewage sludge can assimilate into the marine food web. Accumulation of certain contaminants in the tissues of marine organisms can affect physiological functions, resulting in a compromise of fish health and fecundity, and represents a health hazard to human consumers.

(2) Dredged materials dumped in the ocean can smother and eliminate established populations of sessile or partially mobile benthic communities. Organisms living within these communities are eaten by many species of predaceous fish and invertebrates. These predators often support recreational and commercial fisheries.

(3) Organic sludges and some dredged materials contain excessive levels of compounds that create high oxygen demand. Ocean disposal of these products may result in oxygen depletion or anaerobic conditions over portions of the ocean or estuarine bottom and water column. Such sediments can kill benthic communities and typically alter habitats, causing the proliferation of stress-tolerant organisms having much less value to the ecosystem. Dredged material disposal can prompt the closure of shellfish beds due to pathogenic contamination.

(4) Many disposed materials contain compounds that may promote the excessive growth of undesirable species of phytoplankton in the marine environment. In some cases, the disposal provides the very nutrients that are naturally limiting for planktonic growth. This sudden availability can act as a trigger for plankton blooms.

Increasing concern with the amount of sewerage material requiring disposal, as well as the types of excessive waste contaminants in those materials caused regulatory agencies to examine the effects of ocean disposal. They found that the effects were becoming more pronounced, even at the deepest sites. These findings prompted the passage of legislation prohibiting further ocean disposal and mandating upland processing.

Material suitability:

Although considerable evidence exists equating specific contaminants with damage to the marine ecosystem and fishery resources, the long-term effect of present and past ocean dumping practices remains unresolved but controversial.

The Ocean Dumping Act of 1977 establishes criteria for evaluating dredged material disposal. Suitability of dredged material for ocean disposal is compared, in part, with the London Dumping Convention which identifies contaminants of concern and specifically prohibits disposal of selected toxic materials.

Under current ocean dumping regulations (40 CFR 220 et seq.), only dredged materials that have been evaluated and proven acceptable for ocean disposal may be dumped. Criteria for this evaluation are intended to prevent further degradation of the marine environment. National and regionally dredged material testing protocols have been developed by the EPA and the Corps, in cooperation with the USFWS, coastal states, and NMFS. Materials that do not pass the regional protocols are deemed unsuitable for unrestricted ocean disposal. Confined ocean disposal, known as "capping", is a management alternative for disposal of some materials that fail the initial assessment process. Capping may not be an appropriate management strategy that can be routinely applied to ocean disposal. There may be, however, some sites that capping can be considered to be an acceptable option due to water depth, oceanographic conditions, sediment types, and the scarcity of critical marine habitat.
The guidelines for performing the sediment tests on dredged materials are described in the revised draft, "Ecological Evaluation of Proposed Discharge of Dredged Materials into Ocean Waters" (EPA / Corps 1991), and the regional "Guidance for Performing Tests on Dredged Materials to be Disposed of in Open Waters". The application and interpretation of test results under these guidance documents are discussed in more detail below.

The evaluation procedures for determining suitability of dredged material for ocean dumping emphasize the potential for biological effects rather than the simple presence of possible toxicants. Nonetheless, it is only necessary to proceed through the tiered evaluation process until information is deemed sufficient to determine suitability or non-compliance with the regulations regarding ocean disposal. There are four tiers of analysis:

Tiers I & II rely on existing information and relatively simple testing procedures to determine the potential for environmental impact of the dredged material(s) under review. Those materials with non-existent or minimal levels of toxicant and little likelihood of environmental impact are usually considered to be acceptable candidates for ocean disposal. Materials failing this initial review are subject to the criteria established for subsequent tiers.

In tier III testing, sediment toxicity in the water column, bioassay, and bioaccumulation tests are performed. Benthic community impacts are assessed by comparison of the latter results with reference sediment exposures. If the results show simple open-water disposal unacceptable, then the materials would be tested under tier IV criteria if the applicant or the Corps wishes to continue seeking ocean disposal.

Tier IV is the consideration of steady-state bioaccumulation levels, biological evaluation of dredged material, and the evaluation of "special" management practices that might be employed to mitigate the impacts associated with placing the subject material(s) in the open ocean.

Thus, the determination of suitability for ocean disposal is based, in part, on the outcome of the bioassay and bioaccumulation tests. Bioassay tests quantify the overall toxicity of dredged material through limited but controlled exposure to specific organisms. The regulations consider significant mortality increases above certain levels and increased elevations of body burden of contaminants above similar animals not exposed to the dredged material as potentially undesirable.

Bioaccumulation tests assess the potential for long-term increases in toxic chemical body burden. They are difficult to interpret for a variety of reasons. There is uncertainty in the organismic responses to the physical and chemical regime of the tests which is related to age, sex, size, genetic make-up, and physiological condition of the exposed individuals among other constraints. Many of these sources of variability are not easily controlled.

Management and monitoring:

The EPA has primary responsibility for open-water site management, which integrates permitting, enforcement, monitoring, and data interpretation to evaluate, continually, the appropriateness of ocean disposal. To comply with federal mandates, the EPA evaluates the impacts of ocean disposal by comparing them to pre-disposal, baseline conditions. Specific criteria for monitoring is given in the ocean dumping regulations at 40 CFR 228.10. They include evaluation of the following type of effects: "Accumulation of material constituents (including without limitation, human pathogens) in marine biota at or near the site." In addition, the regulations specify criteria for the categorization of disposal sites. Impact Category I sites may be classified if any of a number of conditions are met indicating degradation in or near it. These conditions include the movement of "waste constituents" from the disposal site, their accumulation in the sediments, water column, or biota of the site, and the consistent identification of toxic concentrations above ambient values outside the site more than four hours after disposal. If such conditions are found, EPA is required to limit use of the disposal site.

The EPA normally conducts annual monitoring surveys at approved or pre-designated

Ocean Disposal sites to determine dredged material distribution and movement (including resuspension and transport), benthic organism colonization of dredged material, sediment chemistry, food chain interactions between benthic and fish of the area, and bioaccumulation of contaminants in benthic organisms.

Other related issues:

In addition to the above restrictions, Section 7(a)2 of the Endangered Species Act (ESA) requires agencies to ensure that proposed projects will not jeopardize the continued existence of listed species. Section 7(a)1 of the ESA places an additional responsibility on all federal agencies to: "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species...". NMFS is developing a recovery plan for sea turtles, and final plans for the northern right whale and humpback whale are complete. These plans describe actions deemed necessary to achieve recovery and could be in conflict with the continued use of some open-water disposal sites. They include implementation schedules that identify the federal agencies best suited to address each recovery action. NMFS will advise and coordinate efforts toward achieving the goals of each plan.

Finally, there is the issue of what are the appropriate levels of contaminants that can be safely placed in the waters of the U.S. Evidence suggests that levels of persistent pollutants such as polychlorinated biphenyls (PCB) and cadmium are rising in the sediments and biota of the continental shelf. Although it is presently impossible to equate those increases to any single cause, dredged material disposal cannot be excluded.

c. Soil disposal, New England and Long Island Sound

Fifteen sites within the waters adjacent to New England and within Long Island Sound have been identified as dredged material disposal sites. Most receive moderate amounts of dredged material from nearby harbor and navigable water maintenance. Some inshore sites are used infrequently for this purpose.

Dredged material disposal sites:

Rockland, ME: Located 3.3 nautical miles (nm) northeast of the Rockland Harbor breakwater, this site has received approximately 193,000 cubic yards of dredged material per year since 1973.

Portland, ME: Located 3.5 nm from the Rockland breakwater, this site has received approximately 158,000 cubic yards of dredged material per year since 1973.

Cape Arundal, ME: Located 2.75 nm southeast of Cape Arundal, this site has received

approximately 123,000 cubic yards of dredged material per year. It was established in 1985.

Foul Area, MA: This site is now called the "Massachusetts Bays Disposal Site". It receives approximately 293,000 cubic yards of dredged material every year.

Buzzards Bay, MA: Located 1.4 nm from Chappaquiot Point, West Falmouth, MA, this site is used infrequently as a disposal site. Since 1979, 92,000 cubic yards of material have been disposed at this site.

New London, CT: Located 2 nm south of the harbor entrance, this site has received approximately 176,000 cubic yards of dredged material per year since 1972.

Cornfield Shoals, CT: Located 6.5 nm southwest of the Connecticut River entrance, this site has received approximately 68,000 cubic yards of dredged material per year.

Central Long Island Sound, CT: Located 5 nm south of the New Haven Harbor entrance, this site has received approximately 368,000 cubic yards of dredged material per year since 1955.

Western Long Island Sound, CT: Located 2.7 nm south of Noroton, CT, this site has received approximately 885,000 cubic yards of dredged material since being opened in the early 1980's.

Infrequently used inshore disposal sites:

St. Helena, ME: Located outside the harbor entrance, this site was last used to dispose of 385 cubic yards of material in 1988. In 1984, approximately 61,000 cubic yards of dredged material were dumped at this site.

Frenchman's Bay, ME: This site is used infrequently for the disposal of dredged material.

Saco Bay, ME: This site was used once, in 1989, for the disposal of approximately 51,000 cubic yards of dredged material.

Sandy Bay, ME: This site was used once, in 1987, for the disposal of approximately 6,000 cubic yards of dredged material.

Sheep Island, ME: This site was used twice, in 1987 and 1988, for the disposal of 2,000 cubic yards and 103,000 cubic yards of dredged material, respectively.

Wellfleet, MA: Located adjacent to the harbor entrance, this site was last used as a disposal site in 1983.

d. Disposal sites, New York Bight

Soil disposal is known to occur at six sites within the New York Bight area. Two are general purpose soil disposal sites and the remaining six are utilized for the maintenance of harbors and navigable waters.

General purpose soil disposal sites:

Mud Dump Site, NJ: Located six nm east of Sea Bright, this site annually receives six to eight million cubic yards of dredged material from the metropolitan New York area. Used as a disposal site since the end of World War II, the site is the major recipient of dredged material from New York Harbor and the navigation channels that serve it. However, this site will reach its capacity by the end of the century, forcing government agencies to establish a new site.

Cellar Dirt Site, NJ: Located approximately eight nm east of Monmouth Beach, this site is exclusively used for the disposal of excavated dirt and rock. New York City disposed of 50,000 cubic yards of material at this site in 1985.

Inlet Dredged Material Disposal Sites (IDMDS):

Rockaway, NY: Located 2 nm southeast of Rockaway Inlet, this site receives the material dredged from the entrance channel through the inlet to Jamaica Bay every two to five years.

East Rockaway, NY: Located 1.3 nm southwest of East Rockaway Inlet, the site has received approximately 200,000 cubic yards of material from the inlet every two years.

Jones Beach, NY: Located 1.5 nm southwest of Jones Inlet, the site has received approximately 300,000 cubic yards of material every two years.

Fire Island, NY: Located 1.7 nautical miles southwest of Fire Island Inlet, the site can receive approximately 250,000 cubic yards of material every year.

e. Soil disposal, New Jersey Sites

Soil disposal in NJ is known to occur at four Inlet Dredged Material Disposal Sites for the purposes of harbor and navigable water maintenance.

Inlet Dredged Material Disposal Sites (IDMDS):

Shark River, NJ: Located 0.4 nm northeast of Shark River Inlet, the site is rarely used for

the disposal of dredged material.

Manasquan, NJ: Located 0.3 nm northeast of Manasquan Inlet, the site received approximately 35,000 cubic yards of material annually through 1978. The site has not been used since then.

Absecon, NJ: Located 0.5 nm southeast of Absecon Inlet, the site received approximately 60,000 cubic yards annually through 1978. The site has not been used since then.

Cold Spring, NJ: Located 1 nm southwest of Cold Spring Inlet, the site has received approximately 11,000 cubic yards of material annually.

f. Soil disposal, Delaware

Federally sponsored dredging projects (Philadelphia District, Corps of Engineers) are less prevalent in DE. Additionally, there are no sites designed for contaminated soil containment.

The chief Federal navigation project in DE is Trenton to the Sea, including Wilmington Harbor and the entrance to the Christiana River. Soil generated from this project is deposited at Cherry Island and the newly constructed 326-acre Wilmington Harbor South Containment Site, both diked upland sites at Wilmington, DE. Additionally, soil mechanically dredged from the channel in Delaware Bay is side-cast at 3 unnamed shoals within the Bay.

Few locally/privately sponsored dredging projects exist in DE; most smaller navigation projects have been taken over by the State. As in MD, soil disposal sites for small navigation projects are located and paid for by a local/private sponsor, and involve a variety of disposal options with limited and/or short term capacity.

Finally, the American Dredge Company, which is currently performing several bucket dredge operations within Delaware Bay, deposits soil at the Klondike Ditch Disposal Site in Logan Township, NJ.

e. Soil disposal, Maryland

Large dredging projects performed in MD (by Baltimore District Corps of Engineers) are hydraulic or hopper dredge operations. Consequently, consideration of both cost and distance between the dredge and disposal sites results in the use of numerous widely distributed disposal options.

Hart Miller Island, a large upland island facility constructed during the mid-1980s, and was

designed to receive contaminated soil dredged from Baltimore Harbor and associated tributaries. The site currently has a remaining capacity of 5.1 million cubic yards (MCY) which will be exhausted during 1993. The life-span of this site was significantly shortened by disposal of clean soil from Baltimore Harbor Channel 50-foot deepening.

Dredge soil from Baltimore Harbor channels within the upper Chesapeake Bay, including approaches to the Chesapeake & Delaware (C&D) Canal, has been placed primarily within several open-water sites collectively called the Pooles Island Deeps. This site receives primarily fine-grained material from hopper dredge operations. This site is currently receiving 2.9 MCY of soil and will be filled to capacity by the end of 1992.

Soil from the C&D Canal (maintained by the Philadelphia District) is deposited at two permanent upland sites along the canal (Turkey Point, and Grove Point) which have a remaining capacity of 7.2 MCY until at least 1994.

With current disposal sites near or at maximum capacity, new soil disposal options are being investigated by a Maryland Port Authority-sponsored task force. An upland site near Cox Creek will provide 6.2 million cubic yards of capacity for contaminated soil. Other options involve shoreline reconstruction (e.g., the Bethlehem Steel site in Baltimore Harbor, 5 MCY of capacity for clean sandy material), and island reconstruction (e.g., Pooles Island, 4 MCY; Dobbins Island, 1.5 MCY; and Poplar Island).

Soil disposal associated with smaller federal navigation, state and local government, and private projects involving either hydraulic or mechanical dredging make use of a variety of soil disposal options generally close to the dredge site. Sites for these projects are provided at the expense of a local / private sponsor, and generally have limited or short term capacity. These options generally include federal / state approved diked upland sites (e.g., Fishing Creek, 62 thousand CY), and beach nourishment (e.g., Eastern Neck Federal Wildlife Refuge, Chester River Navigation Project, 58 thousand CY). However, with increasing scarcity of the latter options, emphasis has been placed on beneficial use of soil, including enhancement of oyster bars (e.g., Neal Sound / Potomac River, 45 thousand CY), creation of submerged aquatic vegetation beds (Smith Island), marsh construction (Kenilworth Marsh, Wash. DC, 150 thousand CY), or wildlife island construction (Bodkin Island, 58 thousand CY).

f. Soil disposal, Virginia

VA currently has two major active dredged material disposal sites, Craney Island and Dam Neck, and one additional Ocean Disposal Site, The Norfolk Ocean Disposal Site, is expected to be designated by the Environmental Protection Agency in the very near future. Craney Island is a diked area which is loaded via a rehandling basin and is used for contaminated as well as "clean" soil. It is rapidly approaching capacity and the Norfolk District COE is

currently seeking a new site. Dam Neck was designated in the late 1980's. It is a relatively small site and was designated to accept clean soil only, primarily from the Thimble Shoals and Chesapeake Channels near the mouth of the Chesapeake Bay. The Norfolk Ocean Disposal Site, when it becomes available, will be restricted to "clean" material only, and will be used for the many dredging projects in the Norfolk area. The Baltimore District COE also has two additional areas designated in the VA waters of the Chesapeake Bay, Rappahannock Shoals Alternate and Wolf Trap Alternate. These sites are used to accept clean material from the Baltimore Harbor Channel.

In addition to the above formally designated sites, a large quantity of material is placed so as to create oyster bars and nourish beaches with project by project approval.

G. State identified essential habitat and fishery surveys

Nearly all sea scallop habitat occurs in the EEZ. The only laws that govern the use of sea scallop fishing occur in the States bordering the Gulf of Maine. Essentially, scallops are found in habitats that occur in state waters that are similar to offshore habitat (Section VI.C). Potentially, scallops survive closer to shore in the northern range because of their susceptibility to temperature and its influence on spawning. state laws (Table 12), either support enforcement of federal regulations with state law enforcement, ensure product quality, or restrict drag size to minimize gear conflicts and/or keep habitat damage (for other species) to a minimum.

H. Programs to protect, restore, preserve, and enhance the habitat from destruction and degradation

1. Federal and state programs

The MFCMA provides for the conservation and management of living marine resources (which by definition includes habitat), principally within the EEZ, although there is concern for management throughout the range of the resource. The MFCMA also requires that a comprehensive program of fishery research be conducted to determine the impact of pollution on marine resources and how wetland and estuarine degradation affects abundance and availability of fish.

The MFCMA established Regional Fishery Management Councils that have the responsibility to prepare fishery management plans which address habitat requirements, describe potential threats to that habitat, and recommend measures to conserve those habitats critical to the survival and continued optimal production of the managed species. The NMFS Habitat Conservation Policy (FR 48(228):53142 - 53147), specifically Implementation Strategy 3, established the basis for a partnership between NMFS and the

Councils to assess habitat issues pertaining to individually managed species.

Other NMFS programs relative to habitat conservation are found in the Marine Mammal Protection Act of 1972, the Endangered Species Act of 1973, the Fish and Wildlife Coordination Act, the Federal Power Act, and the Anadromous Fish Conservation Act of 1965. NMFS shares responsibilities with the FWS for conservation programs under these laws.

In addition to the above mentioned NMFS authorities, other laws regulate activities in marine and estuarine waters and their shorelines. Section 10 of the River and Harbor Act of 1899 gives the Army Corps of Engineers (COE) authority to regulate construction in navigable waters of the U.S. Section 404 of the Clean Water Act of 1977 gives the COE and EPA authority to regulate the discharge of dredge and fill material into waters of the U.S., including wetlands. The COE and EPA jointly administer the 404 program. The EPA, in conjunction with the COE, developed the 404(b)(1) Guidelines which govern COE issuance of section 404 permits. The EPA has veto authority over COE permit decisions. Section 401 of the Clean Water Act gives the EPA or States with approved programs, authority to regulate any activity which may result in discharge into navigable waters. The EPA and COE each have regulatory responsibilities under the Marine Protection, Research, and Sanctuaries Act of 1972.

All of the activities affected by these laws have the potential to adversely affect living marine resources and their habitat. NMFS, EPA, FWS, and state fish and wildlife agencies have authority to review these activities, assess the impact of the activities on resources within their jurisdiction, and comment on and make recommendations to ameliorate those impacts to regulatory agencies. Review and comment authority is provided by the Fish and Wildlife Coordination Act of 1934 (as amended 1958) and the National Environmental Policy Act of 1969. Consultative authority extends to all projects which modify waters of the U.S. and require federal permits or licenses, or that are implemented with federal funds.

Other legislation under which NMFS provides comments relative to potential impacts on living marine resources, their associated habitats, and the fisheries they support include, but are not limited to, the Coastal Zone Management Act of 1972; the Marine Protection, Research and Sanctuaries Act of 1972; and the Endangered Species Act of 1973 (Section 7 consultation). A more detailed discussion of the pertinent legislation affecting the protection, conservation, enhancement, and management of living marine resources and habitat can be found in the NMFS Habitat Conservation Policy (FR 48(228):53142-53148).

In addition, NMFS and the other federal resource agencies are involved in other programs with the States (e.g., NMFS Saltonstall-Kennedy and Wallop-Breaux programs) that provide grants to conserve fish habitats and improve fisheries management.

2. Council policy

Recognizing that all species are dependent on the quantity and quality of their essential habitats, it is the policy of the New England Fishery Management Council to:

Conserve, restore and enhance habitats upon which commercial and recreational marine fisheries depend, to increase their extent and to improve their productive capacity for the benefit of present and future generations. (For purposes of this policy, habitat is defined to include all those things physical, chemical and biological that are necessary to the productivity of the species being managed.)

This policy shall be supported by four policy objectives which are to:

(1) Maintain the current quantity and productive capacity of habitats supporting important commercial and recreational fisheries, including their food base. (This objective will be implemented using a guiding principle of NO NET HABITAT LOSS.)

(2) Restore and rehabilitate the productive capacity of habitats which have already been degraded.

(3) Create and develop productive habitats where increased fishery productivity will benefit society.

(4) Ensure that any fishery management plan which is prepared by the Council with respect to any fishery shall include readily available information regarding the significance of habitat to the fishery and assessment as to the effects which changes to that habitat may have upon the fishery.

The Council shall assume an active role in the protection and enhancement of habitats important to marine and anadromous fish. It shall actively enter federal decision-making processes, to include entering into Memoranda of Understanding with regulatory agencies, where proposed actions may otherwise compromise the productivity of fishery resources of concern to the Council. Participation may be pursued by whatever form appropriate, including but not limited to Memoranda of Understanding.

In support of this policy, the Council proposes several recommendations in § 860 of Amendment #4 to promote habitat conservation for the scallop resource by prohibiting dumping in productive scallop beds.

I. Monitoring programs

The National Status and Trends Program of NOAA (USDC 1987a and 1989b) should provide guidance in making intelligent decisions involving the use and allocation of resources in the nation's coastal and estuarine regions. These decisions require reliable and continuous information about the status and trends on environmental quality in the marine environment. Four initial objectives have been established for this program: 1) to establish a national data base using state of the art sampling, preservation, and analysis methodologies; 2) to use the information in the data base to estimate environmental quality, to establish a statistical basis for detecting spatial and temporal change, and to identify areas of the nation that might benefit from more intensive study; 3) to seek and validate additional measurement techniques, especially those that describe a biological response to the presence of contaminants; and 4) to create a cryogenic, archival specimen bank containing environmental samples collected and preserved through techniques that will permit reliable analysis over a period of decades.

The Council supports the initiatives of the National Status and Trends Program of NOAA to monitor and potentially identify long-term, seemingly innocuous changes in the environment. Although much of this research does and should focus on the interaction between pollution, coastal alteration, wetlands, and their use as spawning and nursery areas, these investigations should be expanded to include ocean waters of the continental shelf. In some areas, the Council found data insufficient to make recommendations on habitat conservation in specific areas that might affect scallops. The Council has, therefore, proposed several recommendations to acquire the basic knowledge necessary to make these assessments. These recommendations are given in § 860 of the amended FMP and include: 1) programs the emphasize long-term synergistic effects of environmental influences, 2) habitat studies that focus on the finer scale resolution, 3) studies on recruitment mechanisms and regional-scale viability of spawning, 4) survey and commercial fishery gear selectivity studies, 5) collection of catch at age data, and 6) investigations on the impact of trawl tow length on undesirable bycatch.

VII. ENVIRONMENTAL CONSEQUENCES

A. Will the proposed action be reasonably expected to jeopardize the long-term productive capability of any stocks that may be affected by the action?

The productive capability of stocks is interpreted broadly in terms of expected changes in stock abundance, impact of habitat quality, and productive capability of the fishing industry. An evaluation of the potential impacts on biological stocks is addressed in this section. This qualitative discussion is followed by the anticipated impacts on by-catch and associated species. These impacts will be a direct result of less fishing for scallops and from redirected effort for other species. Quantitative estimates of future yield and stock abundance of scallops is given later in section VII.F.2.

The potential impacts of the management measures on the fishery and how it responds to the new regulatory environment will directly affect the productive capability of the sea scallop resource in terms of measurable benefits. These anticipated changes due to the moratorium and from effort reduction are further explored in section VII.H based on the propensity for scallop vessels to derive income from other species versus the amount their scallop revenue contributes to the total.

1. Scallop resource

The scallop resource has a recent history of exceptionally high recruitment and record levels of fishing effort. It is considered to be over-exploited, but at high levels of abundance (NMFS 1992a). As a result, landings are at record levels (Figure 2), but the age distribution of harvested scallops is extremely compressed (Figure 20), composed of primarily age 3 and 4 scallops.

Recent recruitment increased through 1989 in the Mid-Atlantic region (Figure 21) but has recently declined. On the other hand, recruitment of small (<70 mm shell height) scallops on Georges Bank has increased to near record levels from a historic low in 1989. Recruitment to the Great South Channel in 1990 and 1991, when taken together, appears exceptional (Figure 22) Scallops in this cohort are expected to be the major component of landings during 1992 and 1993 (Wigley et al. 1991).

Nonetheless, the high level of fishing mortality is expected to eventually cause significant declines in stock size. Reports from fishermen in the Mid-Atlantic region indicate that catch per unit effort is declining rapidly (William Wells III, pers. comm.). This may be a result of the decline in recruitment noted on the scallop survey in 1990 and 1991 (Figure 21). Wigley and Serchuk (1992) conclude that,

"The fishery still remains heavily dependent upon incoming recruitment

and current levels of fishing effort are far beyond what the resource can sustain in the long run (i.e., under conditions of average recruitment). If current fishing practices continue fishing effort will remain high, and the elevated yields due to good recruitment will not be long-lasting."

Following the 14th Stock Assessment Workshop (NMFS 1992a), a "Workshop on Consensus Assessments for Atlantic Sea Scallop" thoroughly examined prior assessments of each resource area. Three (Delmarva, South Channel, and Southeast Part of Georges Bank) of the six major resource areas were included in the final, combined assessment. The Workshop (NMFS 1992b) made the following conclusions regarding the scallop resource:

1) Fishing mortality estimates for two resource sub-areas (Delmarva and South Channel) were previously provided in SARC-12. Consensus best estimates of fishing mortality rates from this Workshop (South Channel=1.9, Delmarva=1.6) still indicate (as in SARC-12) that fishing mortality rates are at least double those resulting in overfishing. Time trends in fishing mortality rates are similar in the present and past analysis.

2) Analyses of fishing mortality rates were extended to two additional resource sub-areas: the Southeast Part of Georges Bank, and the New York Bight. The Northeast Peak of Georges Bank was not considered due to incomplete survey coverage. The Workshop concluded that reliable estimates of fishing mortality for the New York Bight could not be derived at this time. The consensus current fishing mortality rate for the Southeast Part is 0.6.

3) The time-trends in calculated fishing mortality rates and fishing effort (reported days fished) are coherent for the South Channel, Southeast Part and Delmarva. Reported effort has increased in the New York Bight, while apparent fishing mortality rates have declined. It is concluded that fishing mortality rates estimated for the New York Bight are not internally consistent and additional research is necessary to evaluate sources of this inconsistency.

4) Overall estimates of fishing mortality from the three resource areas where reliable estimates of fishing mortality were derived (Delmarva, South Channel, Southeast Part) range from 1.5 to 1.8. These estimates are 2 to 2.5 times the present overfishing definition (then estimated at 0.71 with 3 inch rings and no meat count standard).

5) Some uncertainty exists in key elements of the analysis procedure and data used to compute fishing mortality rates.

The current fishing mortality rate is not only well above the overfishing threshold, but

greatly exceeds the level (0.20 with 3½ inch rings) that would maximize yield per recruit. Both the proposed reductions in fishing effort and the increases in ring and mesh minimum sizes will improve yield per recruit (Figure 23) and reduce the risk of recruitment failure (Appendix V).

None of the proposed management measures, with the exception of removing the meat count, is anticipated to result in cumulative adverse effects on the Atlantic sea scallop. Although there is mortality on discarded scallops, the removal of the meat count and the increase in ring and mesh sizes should reduce discarding. Since heavy exploitation of scallop beds has not been proven to have an adverse effect on scallop habitat, fishing effort of roughly 60% of current levels probably will not harm spat settlement or adult habitat.

2. By-catch and associated species

A major concern about the Atlantic sea scallop fishery has been the amount of by-catch from scalloping. Table 20 presents a list of species landed as by-catch from scallop dredges and trawls during 1991. Of the most common species, only goosefish (Lophius americanus), yellowtail flounder (Pleuronectes ferruginea), and winter flounder (Pleuronectes americanus) are landed in sufficient volume to warrant concern. Of these species, the flounders are managed under the Multispecies FMP. Although idle scallop vessels may target these species, Amendment #5 to the Multispecies plan is under development and will most likely provide for a trip limit on groundfish by-catch.

The reverse is true for goosefish. Scallop dredge and trawl landings of goosefish account for 40% to 50% of total landings. NMFS (1992a) considers this species to be at least fully-exploited and possibly overfished. Although there is not yet a definition of overfishing for goosefish, fishermen report declines in the size of goosefish tails and this species has become a concern of the Council. With the assistance of the Mid-Atlantic Fishery Management Council, the New England Fishery Management Council is in the initial stages of developing an FMP for goosefish. Scallopers will probably redirect their fishing effort on goosefish when they are not able to fish for scallops. This potential increase in effort on goosefish might be counterbalanced by decreases in scallop fishing effort which will reduce the by-catch of goosefish.

Benthic species, mainly invertebrates (echinoderms, polychaetes, hydrozoans, and molluscs), and other benthic debris are often caught in the process of catching scallops. The effort reduction and increases in ring and mesh size should decrease the mortality on these species by at least 40 percent. Although some opportunistic species benefit from scallop fishing by feeding on suspended material, finding shelter in the dredge tracks, and making use of discarded shell, other species will likely benefit from the reduction in scallop fishing. In order to examine the potential impacts on stocks and fisheries in the region, eleven groups of landed species were considered to represent a large majority of fishery products

landed in the Northeast and Mid-Atlantic regions. They are possible alternatives for vessels which may be prohibited from future participation in the scallop fishery. Landings and revenues by all vessels identified in the NMFS weighout data are used. The data also include information about the ports and gears used by vessels on each trip.

B. Will the proposed action be reasonably expected to allow substantial damage to the ocean and coastal habitats?

Scallop dredging causes substantial physical disturbance to the environment since the dredges are designed to scrape the sea floor. Caddy (1968) noted that dredging dis-lodged buried shell buried gravel under resuspended sand as well as overturned larger rocks with an appreciable roughening of the sediment surface. An aggregation of fish and predatory invertebrates in the dredge track immediately after fishing were also observed.

There are very few instances of habitat degradation due to fishing. Although there have been some observations of decreases in mesofaunal and aerobic speciation following dredging, several areas having high fishing effort did not exhibit declines in future scallop recruitment. Although some species, notably echinoderms, polychaetes, hydrozoans, and molluscs, are affected by habitat alteration and discard mortality, other opportunistic species may use the dredge tracks, feed on suspended matter, and find suitable habitat among the discarded shell.

1. Effects on the Coastal Zone

Amendment #4 is consistent with CZM programs of the Northeast and Mid-Atlantic coastal States. Other than the possibility of increased shore-side processing which would measurably increase discards of viscera and shell, Amendment #4 will not cause additional activities which adversely impact the coastal zone. It is not known if or how much additional shell stocking and shore-side processing will occur from the effort reduction and crew size limitations.

2. Effects on Flood Plains or Wetlands

Amendment #4 is not expected to have any affect on flood plains or wetlands, and trails and rivers listed or eligible for listing on the National Trails and Nationwide Inventory of Rivers.

C. Will the proposed action be reasonably expected to have a substantial adverse impact on public health or safety?

The proposed action has both direct and indirect impacts on public health and safety. Indirect impacts which affect the health of fishing communities include changes to fishery employment, communities, historical practices and cultural aspects, and small business.

These factors are summarized in the Social Impact Analysis.

Directly, the proposed action is not expected to jeopardize the public health and safety via degradation of product quality. This potential impact from the management program is discussed in section V.G.5.b, however, the specific issue of trip lengths which affects both public health via product quality and safety for scallop fishermen is discussed below.

1. Trip lengths

Trip lengths have a direct impact on the quality of all sea scallops that are landed unfrozen, which is the predominant practice. Longer trips cause greater product degradation unless handling and processing practices are vastly improved.

Scallop trips ranged from one to twenty-eight days at sea from 1988 to 1990 (Figure 19). Ninety percent of the 15,000 trips examined were less than 15 days, with a mode at 12 days. Trips by full-time scallopers generally lasted more than eight days, but those by the part-time fleet were frequently shorter.

One of the problems frequently cited by fishermen and dealers is today's long trips and reduced product quality. Vessels are making longer trips which translate into more fishing time and less transit time. Many vessels now search for larger scallops to mix with more abundant small scallops to comply with the meat count (Sutinen et al. 1992). Thus, the length of scallop trips increases when scallops are predominately small or the yield is low. High fishing mortality is a major cause of few large scallops. None of the effort reduction alternatives would continue the meat count. This measure is only included as an option in place of additional gear restrictions on ring and mesh size.

Neither the preferred alternative, or the 22 vessel class days at sea allocation (Section V.G.2) are expected to lengthen trips. In fact, there will be an incentive to reduce transit time to fishing grounds to maximize the ratio between days fished and days at sea, and to fish on scallop resources closer to port. If this occurs, trip length could shorten.

The adjustable layover alternative (Section V.G.3) causes the most safety concerns. Because the layover period will not depend on trip length, longer trips cause less layovers to occur within a year's fishing. As a result, vessels will stay at sea as long as possible to maximize their fishing time. The fixed layover day system is expected to cause an incentive to lengthen trips more so than the meat count regulation.

Potentially, the fixed layover period will cause fishermen to sail after the layover regardless of weather. Although this alternative includes a 10,000 pound trip limit, it is not expected to be very effective in reducing trip length. The trip limit will only be effective when catch per unit effort is high. Given the current number of vessels and effort, the trip limit will

exceed actual catches and therefore not reduce catch levels when scallop stocks are at medium or low abundance (Table 9 and Appendix III).

Fishermen will use their layovers to offload and prepare for the next trip. Since there will be no flexibility in extending one layover and shortening another, extended vessel maintenance will greatly reduce the opportunity to fish. As a result, vessel maintenance will often be performed quickly during layovers.

The adjustable trip limit alternative (Section V.G.4) will cause shorter trips if they are set correctly to achieve the interim fishing mortality objectives. On one hand, the fixed layover day will create an incentive to lengthen trips, but the trip limit will restrict fishermen's ability to do this as long as at-sea transfers are prevented. This alternative will cause landings from nearly every fishing trip to be at the trip limit. It also puts pressure on fishermen to begin their next trip regardless of the weather.

2. Impacts on safety

Fishermen placed in a marginal economic position as a result of a restrictive management system, may make different decisions about going out or staying in than they would under less stressed financial situations. The direct relationship between risk, or casualty rates, and management measures, however, cannot be established. The increased competition brought upon the industry by dwindling stocks and increasing effort (including the edge given by improved technology or fishing methods), on the other hand, will have a greater influence on the individual's decision-making. To the extent that mismanagement of the fishery allows the stocks to reach an overfished condition, a condition where competition for fish is intensified and business survivability is threatened, there is some connection between management systems and safety.

The alternatives that are proposed were developed with safety as one of many considerations. The preferred effort reduction alternative allows more flexibility for fishermen to pursue other fisheries (and declare out of scalloping) or to remain in port than the non-preferred options which employ trip limits and layover days. Predicting the impacts of these measures on the safety of individuals can only be done qualitatively since data is lacking. More significantly, it is difficult to predict future behavior and decision-making by fishermen. A measure that maximizes individual flexibility, such as an allocation of days at sea monitored by an electronic VTS, would be less likely to negatively affect safety than a system that creates a "derby" atmosphere, such as an aggregated quota system, in which individual vessels compete against each other for a limited amount of fish.

The non-preferred trip limit and layover day alternatives (sections V.H.3 and V.H.4) would effectively reduce the potential "derby effect" that would occur with an aggregate quota

system or with trip limits alone. On the other hand, if the weather is unsuitable for fishing at the end of a layover period, a fisherman may be forced to sail in inclement weather to make as many trips as possible to meet his financial obligations. The potential for this type of risky decision, although it exists under any possible fishery management program, is heightened under a forced layover system.

The moratorium is also not expected to have a negative impact on public safety. While the moratorium does not allow additional permits, vessels which qualify for a permit may be upgraded within certain limits on size and horsepower increases. Thus, vessels may be upgraded or modernized without significantly increasing fishing power (to the extent that length, tonnage and horsepower affect fishing power).

This amendment is being developed at a time when a comprehensive set of regulations are being promulgated under the Commercial Fishing Vessel Safety Act of 1988, PL 100-424. While some of these regulations are not yet final, they include stability and construction standards for certain vessels, requirements for survival craft and other safety equipment, and other measures to improve the overall level of safety of the industry. How these regulations will interact with the proposed management measures cannot be evaluated until the proposed regulations are available.

It is not expected that the proposed action, including the limits on vessel upgrading and total effective fishing power, would cause conflicts with other vessel safety regulations. It is unlikely that the proposed safety regulations would require vessel owners to buy a larger vessel or to increase a vessel's horsepower. The proposed action places no limits on the use of EPIRBs, communications equipment, radar, survival suits, or liferafts. It is also unlikely that the managment measures will affect a fishermen's ability to properly store safety items onboard. Both the proposed fishery management and safety measures will, however, cause significant financial burdens on fishermen. Although the Magnuson does not authorize financial assistance measures to burdened fishermen, the government should consider and offer assistance to fishermen who are most severely impacted by the synergistic effects of regulations.

Alternatively, the VTS requirement for the full and part-time fleets is expected to tangentially improve the overall safety for fishermen. Since a vessel's position could be quickly determined by a remote observer, e.g. the U.S. Coast Guard, and these instruments provide another means of ship-to-shore communication with greater range than VHF or cellular telephone, location and emergency response time might be significantly reduced.

D. Will the proposed action be reasonably expected to adversely affect an endangered or threatened species or marine mammal population?

The Council has concluded that any fishing activities, which either are or may be carried

out under this FMP and its proposed amendments, will have no affect or are not likely to adversely affect any threatened or endangered marine species. NMFS has concurred with this opinion (Appendix IX) and has determined that further consultation is unnecessary.

Most of the information supporting this conclusion was not contradicted during public hearings. Scallops exhibit life history characteristics such that fishable concentrations occur in areas having very infrequent co-occurrences of marine mammals and sea turtles. Other researchers, however, indicated that the average tow times for scallopers using trawls was significantly greater than that stated in the draft documents. Additionally it is known that long tow durations in other trawl fisheries adversely impacts marine mammal and sea turtle survival. Nonetheless, these researchers concurred that scallop trawlers have few encounters with marine mammals or sea turtles because of the geographical location of fishing. If scallop trawling expands into areas having more frequent concentrations of endangered or threatened species, the longer tow durations may become an issue. For this reason, the Council recommends (§ 860) that NMFS consider observer coverage aboard scallop trawlers where co-occurrences of endangered or threatened species potentially exist. This monitoring will assure early determination if this becomes a problem.

E. Does the proposed action in concert with other laws, regulations, or plans potentially result in cumulative adverse effects having a substantial effect on the target resource species or any related stocks?

The proposed action does not create serious conflicts with other laws, regulations, or plans governing the marine resources or associated fisheries. By itself, the action is expected to reduce scallop mortality and improve the stock's health. The reduced fishing effort is also expected to decrease the by-catch of associated species (section VII.A.2) and, where scallop dredging has the potential for damaging habitat, it will allow improvements in habitat quality. There is very little evidence that scallop fishing causes habitat destruction (section VI.E.1), but Amendment #4 urges small scale environmental studies (§ 860) to illustrate potential impacts.

The proposed action is intended to decrease excess fishing capacity on scallops. As a result, some fishing effort by qualified and especially disqualified vessels is expected to be redirected to other fisheries, namely summer flounder, monkfish, mackerel and squid, and to a lesser extent, groundfish. Summer flounder and squid are managed by an established quota and if effort is transferred to these fisheries, the result would be an earlier closure. No detrimental impact on these stocks is expected. Redirected effort for groundfish is problematic under the Multispecies FMP, but the Council expects to shortly amend the plan to limit effort in these fisheries as well. The proposed actions under the Multispecies FMP will limit entry of new vessels from other fisheries. Monkfish are currently unmanaged and NMFS has determined the species to be "at least fully exploited, and potentially over-exploited" (NMFS 1992a). Without management measures to protect

monkfish, the proposed action may pose an adverse impact for this species. Mackerel are currently under-exploited (NMFS 1991c).

The proposed action does not pose any additional problems for administration of the Outer Continental Shelf Lands Act (PL 95-372), the Marine Protection, Research and Sanctuaries Act of 1972 (16 U.S.C. 1431 et seq.), or for treaties binding the U.S. to the International Court of Justice's decision establishing the east coast maritime boundary between U.S. and Canada. In fact, the proposed action is expected to decrease the incentive for U.S. fishermen to violate that agreement. U.S. scallopers infrequently venture into more productive Canadian waters to augment their catch. Part of the reason is related to the greater scallop abundance on the Northeast part of Georges Bank. The other reason for this activity results from U.S. fishermen being unable to find sufficient quantities of large scallops to comply with the meat count. If the proposed action is effective, the biomass of adult scallops is expected to triple and the abundance of large scallops will increase over levels expected if management is unchanged.

Lastly, the proposed management measures will limit scallop fishing effort and are intended to cap total effective fishing power for qualified vessels. Certain programs administered under U.S. law [especially Title XI of the Merchant Marine Act of 1936 (46 U.S.C. 1271-1280)] encourage financial investment in U.S. fisheries by providing loan guarantees or by otherwise reducing risks associated with fishing. The Council's files are rife with correspondence and dialogue over the effect of maintaining or increasing capital in fisheries that have reached or surpassed full exploitation. Even when these funds or special treatments are applied to under-utilized species, excess capital for fishing vessels can be temporarily redirected but often returns to traditional species when either the market disappears or the alternative species reaches full exploitation. New financial assistance programs similar to the Fishing Vessel Obligation Guarantee Program and the Fishing Vessel Capital Construction Fund should be carefully evaluated for their long-term impact on the scallop resource and management program before implementation.

F. Economic Effects of the Proposed Action

The economic analysis of Amendment #4 includes a qualitative evaluation of the short-term impacts and a quantitative analysis of the long-term impacts. The short-term analysis compares the expected impacts on individual vessels among the four effort reduction alternatives. The various proposed management measures are similar in that their goal is to reduce fishing mortality over the same seven year schedule. Fishing mortality is controlled via days at sea restrictions (Section V.C.2 and V.G.2), layover periods (Section V.G.3), or trip limits (Section V.G.4). Each measure is set to achieve the interim fishing mortality, and in some cases, requires annual adjustments because of changes in abundance and partial recruitment. These management measures affect each vessel's operations differently, depending on its profitability, method of fishing, and flexibility in

compensating for management restrictions. This impact is analyzed in the short-term to determine when certain types of vessels become uneconomic.

The long-term cost-benefit analysis examines the expected revenue and compares them to lowered costs caused by reductions in fishing effort. The expected landings (biological yields) are exactly the same for days-at-sea, layover day, and trip limit reductions, because all of these alternatives are designed to achieve exactly the same reduction in fishing mortality over a seven year time period. The long-term analysis includes two options to No Action, one which has a 3" dredge ring size requirement (Section V.G.5), and the other a 3¼" requirement (the preferred alternative, Section V.E.6.a), during the first two years of implementation. Either of these options apply to any effort reduction alternative. All alternatives require 3½" dredge ring size after year two.

1. Short-term qualitative assessment

A short-term qualitative assessment is based on the 1987-1990 operations of 35 Mid-Atlantic scallopers, and additional detailed information on trips which were exempted from meat count regulations aboard 11 vessels during 1990 (DuPaul and Kirkley, unpubl. data). Appendix VI provides detailed explanation of their findings. Some of the experimental management restrictions do not correspond to the alternatives proposed in Amendment #4. For example, Appendix VI examines the profitability of various trip limits with a four day layover, while the adjustable trip limit alternative includes a six day layover. Therefore, while inferences can be drawn from this analysis, quantitative predictions of the probability for scallop vessels becoming uneconomic and exiting the fishery is not possible.

The short term impacts evaluated below were completed during the development of Amendment #4 management alternatives. The trip limit and lay-over alternatives were evaluated using limited data on vessels fishing under conditions slightly different from the alternatives being proposed. These limited studies, however, are the closest approximation of the short term economic outcomes and inferences are drawn to estimate the potential impacts. The mechanism for allocating days at sea to scallop vessels was significantly changed as a result of public concern about the proposals. The effect on the number of vessels assigned to groups and the impact on the yield projections was re-estimated. The number of vessels within each group cited below has been updated. Because of these changes, the severity of impact relative to recent fishing activity is different. Unfortunately there was insufficient time to revise these estimates.

a. Effort reduction with full-time/part-time/occasional vessel groups (preferred alternative)

The scheduled reduction in days at sea for the 113 occasional, 100 part-time and 190 full-time vessels is shown in Table 1 for base fishing mortality = 2.25 (best case) and Table 2 for

base fishing mortality = 1.50 (worst case). The number of vessels automatically qualifying under the proposed moratorium is 403. The finite cap on the number of vessels allows the calculation of the number of days for each group.

Appendix VI (Tables 4-5) shows the effects on vessels' operations and financial returns (annualized) for three levels of annual days at sea, which apply only to the full-time group. These economic impacts are a) based on trip level data from 35 Mid-Atlantic vessels operating only in the Mid-Atlantic resource area between 1987 and 1990, and b) averages across all vessels by size. Therefore, the information used in this short-term analysis must be considered qualitative, rather than quantitative. The limited sample size and potential for bias may not allow the results to be applicable for the entire fleet.

The analysis shows that scallop vessels will lengthen their fishing trips to increase profitability (to get more days fished per day at sea) under a days at sea restriction. Vessels in class 3 (51-150 Gross Registered Tons) maximize profits at about a 15-day trip; class 4 (151-500 GRT), a 23-day trip. On the average, a 200 day per year allocation should allow most vessels in the full-time fleet to remain economic in the first year with sufficient revenues and returns to owner, captain, and crew. However, vessel operations will yield revenues that are insufficient, on average, to cover the fixed costs for either tonnage class 3 or 4 vessels with a 150 day per year allocation, is projected for year four if a 57 percent effort reduction is needed (Table 1), or in year five if a 35 percent effort reduction is needed (Table 2).

Differences among vessels were also examined, with the 1990 performance of 11 individual vessels in Appendix VI. All eleven vessels would be considered to be in the full-time category under the preferred alternative.

A restriction of 225 days at sea on these eleven (the full-time group will be allocated 201-205 days at sea in year one, Tables 1 and 2) would allow higher landings and revenues than their actual 1990 performance. A 150 day restriction will force reductions ranging from 1% to 27% of 1990 revenues. Full-time vessels are scheduled to receive 150 days in 1997, 118 days in 1998-1999, and 87 days in 2000 and beyond (Table 2).

The 1990 fishing activity for vessels that will be classified as full-time scallopers was compared to various days at sea restrictions to examine their impact on individual vessels. Because the full-time group includes vessels with a wide range of historic fishing activity (>150 days), allocations of allowable days at sea for 1994 will have a significant impact on vessels who fished frequently during 1990. The most active boat fished 330 days at sea during 1990.[2] This vessel will absorb nearly a 38 percent reduction in fishing time relative to its 1990 fishing effort. Conversely, vessels that fished just over 150 days will be allowed

[2] Source: NMFS weighout data, 1990.

up to a 37 percent increase in effort.

Overall, approximately 55 percent of vessels in the full-time category will be required to reduce their fishing effort relative to 1990 levels (Figure 24). Because of the unequal distribution of fishing effort around the group mean, on average, vessels in the full-time category will not reduce their fishing activity relative to 1990 levels. A days at sea limit from 180 to 220 days is not statistically different than the group 1990 mean days at sea. Alternatively, if 3" rings are implemented for years 1 and 2 in lieu of 3¼ inch rings, the allowable level of fishing time allocated to the group would be 188 days at sea. Approximately 80 percent of full-time vessels would take effort reductions relative to 1990 levels if this option were implemented.

As time at sea for scallops is reduced, a greater proportion of scallopers will be impacted relative to 1990 levels. At the minimum level of allowable effort (87 days for 2000, Table 2), about 90 percent of full-time vessels will have reduced their effort. Ten percent would not be affected, even at these much reduced levels, because these vessels did not fish at full-time levels in 1990, but qualify for the group based on their 1985 to 1990 performance.

Likewise, vessels classified in the part-time group will experience a wide range of impacts due to the initial effort reduction. For the purposes of this analysis, the part-time and the occasional groups were combined. Individually, those part-time and occasional vessels will experience a significant range of impacts, but the extremes are more limited. Vessels with fishing histories at the upper end of the class, e.g. 149 days and 37 days, will absorb a n immediate reduction in fishing effort of 38 and 49 percent for part-time and occasional classed vessels, respectively. At the other end of the spectrum, some vessels will be able to increase their fishing effort substantially.

Because some scallopers significantly increased (or decreased) their fishing activity during 1990, the actual range of impacts is much greater. For example, approximately 20 percent of vessels in the part-time and occasional groups had 1990 fishing histories in excess of 150 days at sea (Figure 25). These vessels fished at a full-time level for that year, but qualify at a lower level based on their 1985 to 1990 history. Conversely, about 10 to 15 percent of vessels in these groups had little or no fishing activity during 1990. The latter vessels may represent some vessels that qualify under the moratorium, but were replaced by vessels that will qualify under appeal. They also may represent vessels from areas not adequately covered by the NMFS weighout system, but had trips recorded in the system during 1985 to 1990.

Summary: The initial effort reductions are likely to make few vessels uneconomic. These vessels will generate enough revenue to cover their fixed and variable costs. Of course, those vessels that are currently operating on the margin (i.e. have no profit) will become uneconomic with any decline in yield. These results should be interpreted with caution,

however, because the analysis was conducted during a single year, 1990. The resource was considered to be at a high level of abundance during this period. Future yields (Section VII.F.2.a) are projected for a wide range of recruitment possibilities. If recruitment falls to what is considered to be average or below average levels, many vessels will become uneconomic, regardless of the management in place at that time.

It is expected that, in the latter years of the effort reduction schedule, gains in stock size, catch-per-unit-effort, and yield are expected to occur and improve profitability to individual vessels. This analysis based on 1990 stock levels and operating margins, however, suggests that declines in yield and reductions in days at sea for years 3 and possibly 4 will cause economic hardship on a meaningful number of qualifying vessels.

b. Effort reduction with 22 vessel groups (Section V.G.2)

The scheduled reduction in days at sea for various groups of scallop vessels is presented in Table 4 (Worst Case) and Table 5 (Best Case). The number of vessels qualifying under the proposed moratorium is 403 and allows the calculation of the number of days for each group.

On average, a 200 day per year allocation will allow most of the vessels in the fleet to remain economic with sufficient revenues and returns to owner, captain, and crew. However, vessel operations will yield revenues that are insufficient, on average, to cover the fixed costs for either tonnage class 3 or tonnage class 4 vessels with a 150 day per year allocation.

Differences among vessels are also examined, based on the 1990 performance of 11 individual vessels (Appendix VI). Seven of these vessels represent Group J in Tables 4 and 5 (238-262 days at sea range), two represent Group H (188 212), one represents Group I (213 237), and one represents Group K (>= 263).

Group J vessels are each scheduled to have 239 days at sea in 1994 (the first year of implementation), and 214 days in 1995-1996 (Table 5). Appendix VI shows a restriction of 225 days at sea allows all seven to have higher landings and revenues in 1990 than they actually did due to relaxation of the meat count standard. Thus, Group J vessels are expected to be better off under this alternative, if recruitment remains average or better, for at least the first year of the program. In 1997 and 1998-1999, these vessels are scheduled for 192 and 170 days at sea, respectively. The 150 day restriction (Appendix VI) imposes extreme reductions in landings and revenues (from 16% to 22% of 1990 revenues) to these boats. They are not able to shift fishing effort to compensate for the large reductions. These vessels will be restricted to 148 days at sea, however, in 2000 and beyond under the Best Case. Under the Worst Case, the 2000 level for Group J vessels is 99 days at sea. However, comparisons with the analysis in Appendix VI are meaningless in the latter years of the effort reduction schedule because expected gains in stock size, catch-per-unit-effort, and yield are expected to occur and improve profitability to individual vessels.

The two vessels in Group H, from Appendix VI, are expected to experience similar effects. A restriction of 225 days at sea allows higher landings and revenues than their actual 1990 performance and a 150 day restriction forces reductions, but only a 1% reduction in 1990 revenues for both vessels. Group H vessels are scheduled to receive 157 days at sea in 1997 (Table 5), 139 days in 1998-1999, and 121 days in 2000 and beyond.

The single vessel in Group I analyzed in Appendix VI also shows similar effects, with a 14% reduction in 1990 revenues for 150 days at sea. Group I is scheduled to have 176 days at sea in 1997 (Table 5), 156 days in 1998-1999, and 136 days in 2000 and beyond. The sole Group

K vessel bears reductions in landings and revenues with both 225 (from $1,141 to $1,087 thousand) and 150 (27%) days at sea restrictions. Group K vessels are scheduled to receive 248 days at sea in 1995-1996 (Table 5), 223 days in 1997, 198 days in 1998-1999, and 172 days beginning in 2000.

This analysis suggests that vessels in the lower performance levels (e.g. less than 187 days at sea average between 1985 and 1990), will face the smaller reductions in landings and revenues under days at sea restrictions. This occurs because vessels that, in the past, fished a lower amount of days have the opportunity to shift fishing effort and adjust trip lengths to the most productive times and methods. However, since no vessels that would be in the lower performance groups (A through G) were analyzed, these results should be interpreted cautiously.

Because there are more performance categories under this alternative, the short term impacts on individual vessels are much less than under the preferred alternative. Conversely, since the performance ranges in historical scallop fishing are much narrower, this alternative limits the amount that individual vessels can increase their fishing if their average falls below the class mean.

For example, the preferred alternative allows a vessel that had a history of having 150 days at sea directed at scallops to increase its fishing to the group mean of 205 days (Table 2). Under this alternative, that vessel would be classified in Group F with an initial allocation of 146 days at sea.

Vessels at the upper end of the ranges are likewise not as burdened under the 22 group alternative than under the preferred. For example, a vessel with a history of scallop fishing at 135 days at sea would be classified as a part-time scalloper under the preferred alternative. Its initial allocation will be 92 days at sea. Under the 22 group alternative, its initial allocation will be 123 days at sea, a net increase of 31 days relative to the preferred alternative.

This type of analysis is applicable to all vessels with histories at the extremes of the full-time, part-time, and occasional groups under the preferred alternative. This net impact is summed for the 421 vessels within the 22 groups in Figure 26. On the average, slightly more than half of the vessels will not be impacted (have reduced days at sea) relative to their 1990 fishing effort. Because of a skewed distribution of effort, the average impact relative to 1990 levels is about a 10% reduction. Because the groups have narrower classifications, these bounds in the range of impacts are considerably narrower than the full-time / part-time analysis.

Summary: When compared to the economic performance of the study group, the projected effort restrictions are not expected to cause large numbers of vessels to be uneconomic. Of

course, those vessels that are currently operating on the margin (i.e. have no profit) will become uneconomic with any decline in yield. These results should be interpreted with caution, however, because the analysis was conducted during a single year, 1990. The resource was considered to be at a high level of abundance during this period. Future yields (Section VII.F.2.a) are projected for a wide range of recruitment possibilities. If recruitment falls to what is considered to be average or below average levels, many vessels will become uneconomic, regardless of the management in place at that time.

An allocation of days at sea to vessels classified into 22 groups will impact some vessels significantly less than the preferred alternative. Conversely, many vessels will not be able to increase fishing effort from prior levels to raise their activity to the group mean. The difficulty with using a 22 group classification system comes from the veracity of the data. Many feel that insufficient data will cause mis-classification of a substantial number of vessels and require an extended appeal process in order to correct the historic records.

c. Increases in layover days (Section V.G.3)

The scheduled reduction in days between trips with a fixed 10,000 pounds per trip for full-time and part-time scallop vessels is presented in Table 6 (Worst Case) and Table 7 (Best Case). The number of vessels qualifying under the proposed moratorium is 421 and allows for calculation of the necessary layover based on historic fishing behavior, the number of vessels fishing, and the total allowable days at sea.

Appendix VI (Tables 1-2) shows the effects on vessels' operations and financial returns (annualized) for three levels of layover days and a fixed 10,000 pound trip limit. From that analysis, the 1:2 proportional layover (one layover day for each day at sea) corresponds to the 6 day layover on the schedule; the 1:1, to the 12 day layover.

The analysis shows that scallop vessels will be forced to shorten their fishing trips (14.33 days per trip for class 3 vessels, and 10.12 days for class 4) with a 10,000 pound trip limit. With six layover days, corresponding to 1:2 in Appendix VI, both tonnage class 3 and 4 vessels are expected to cover fixed costs and provide adequate compensation to owner, captain, and crew. When the layover requirement falls to 9-12 days in 1996 under the Worst Case scenario, both class 3 and 4 vessels fail to cover fixed costs, falling below their required $215,000 and $330,000 boat stock requirement, respectively. This situation might be worse for the part-time fleet when layover days increase to 15 in 1995 and higher beyond that. Like the prior analyses, comparisons with the analysis in Appendix VI are meaningless in the latter years of the effort reduction schedule because expected gains in stock size, catch-per-unit-effort, and yield are expected to occur and improve profitability to individual vessels.

d. Adjustable trip limits (Section V.G.4)

The scheduled reduction in catch per trip with a fixed six days between trips for full-time and part-time scallop vessels is presented in Table 8 (Worst Case) and Table 9 (Best Case). The number of vessels qualifying under the proposed moratorium is 421, and allows for calculation of the necessary trip limits based on historic fishing behavior, the number of vessels fishing, and the annual target yields (estimated from the interim fishing mortality rates and the current stock abundance).

Appendix VI (Tables 1-2) shows the effects on vessels' operations and financial returns (annualized) for three levels of layover days and a fixed 10,000 pound trip limit. This alternative is most closely approximated by the four day layover and the one day layover per two days at sea. Additionally, supplemental material has been provided to estimate the impacts of trip limits ranging from 6,000 to 15,000 pounds and a fixed four day layover. A fixed six day layover is expected to reduce the anticipated financial returns from those presented here.

The analysis in Appendix VI uses long-term average resource conditions, and is thus most comparable with the medium recruitment columns in Tables 8 and 9. The analysis shows that even with a 10,000 pound trip limit, scallop vessels will be forced to shorten their fishing trips (14.33 days per trip for class 3 vessels, and 10.12 days for class 4) relative to the days at sea alternative. With a 6,000 pound trip limit or less, which is required throughout the period for both Best and Worst cases at mean recruitment, only class 3 vessels continue to cover fixed costs and provide adequate compensation to owner, captain, and crew while class 4 vessels fall below their required $330,000 boat stock requirement. A fixed six day layover, however, causes financial hardship for both vessel classes even at an 8,000 pound trip limit. That is, class 3 vessels average boat stock declines from $259,000 to $200,000 with an 8,000 pound per trip limit, not enough to cover their $215,000 boat stock requirement. With six layover days, a 9,000 pound trip limit would not be reached until between 2001-2002, and only at high recruitment throughout the period.

Summary: Since the profit potential of fishing for scallops is largely based on the trip, the analysis of this alternative is probably the most accurate use of the 1990 data (Appendix VI). Although trips will become shorter if trip limits are reduced and stock abundance increases, the nominal trip will land a pre-set amount of landings. As such, profitability is limited with the adjustable trip limit based alternative. If the economics of the entire fleet is similar to the eleven vessels examined by DuPaul and Kirkley (Appendix VI), then a large portion of the 403 qualifying vessels will be uneconomic, except in the latter portion of the effort reduction program only if recruitment is high.

2. Landings forecasts from a stochastic yield model

During the March 1993 public hearings, the Council projected future yields under several

management alternatives based on a semi-linear effort reduction strategy with 160 full-time vessels and a fishing mortality that declined from 1.5 to 1.46, 1.31, 1.31, 1.19, 1.08, 1.08, 0.97 during 1993 through 1999, respectively. For the non-preferred 3 inch rings option, the fishing mortality schedule was linear with two pause years, 1.5 to 1.34, 1.18, 1.18, 1.11, 1.04, 1.04, 0.97. Similar schedules were evaluated for the case when current fishing mortality equaled 2.25. As a result of public comments regarding the impact of the allocation system and the voluntary data system upon which it was based, the Council voted to allow days at sea allocations based on less stringent qualification requirements. At the same time, it required the group allocations of days at sea for the first three years to remain unchanged from the amounts published prior to public hearings. These actions resulted in the expected number of full-time scallop vessels to rise from 160 to 190 and caused the projected fishing mortality rates to rise over previous estimates.

In addition, the former yield estimates were projected beginning 1993, two years after the latest assessment data. As of 1993, the scallop stock was expected to have significant contributions of scallops from the high 1989 year class. Since those projections were made, a sufficient amount of time has passed to justify beginning the yield projections in 1994 rather than 1993. The effect of this action does not alter the expected changes in yield and revenue because they were compared to the status quo. Nonetheless, the former projections of a precipitous decline in yield from 28 to 34 million pounds in all three cases with average recruitment no longer exists, an outcome verified by the drastically reduced catch reports for 1993.

The response of the scallop stock to changes in effort were simulated using an age-structured model, SIMCON (Mace 1991). The model uses standard population dynamics equations to predict catch and future stock levels. It requires input data on the current stock biomass and age structure, weight at age, fecundity, mortality (fishing and natural), and recruitment. These data were derived from Stock Assessment Workshop documents.

One thousand runs were made for each set of mortality reduction schedules to estimate yield for eighteen years in the future, three years to simulate changes in population structure at current fishing mortality and fifteen years (1994-2008) with the proposed management measures. Yield projections were conducted for case when 1) fishing mortality and partial recruitment are unchanged, i.e. the No Action alternative, 2) fishing mortality is reduced to the overfishing definition in seven years and partial recruitment is adjusted for removal of meat count restrictions and the use of 3½ inch rings beginning in year 3, and 3) fishing mortality is reduced to the overfishing definition in seven years and partial recruitment is adjusted for the use of 3¼ inch rings in years 1 and 2 and the use of 3½ inch rings beginning in year 3. All three cases were computed at two different levels of current F, 2.25 and 1.50. Table 21 shows the fishing mortality and partial recruitment parameters used to calculate future years. Recruitment was assumed to occur as a random process (not related to spawning stock size) with a log-normal distribution. This

assumption was made because the PDT could not discern an apparent stock recruitment relationship for various levels of spawning stock biomass.

In addition to projecting future yields, the model was validated by back-calculating yield between 1982 and 1990 using data from the stock assessment (NMFS 1992b). Back-calculated yields agreed quite well with observed landings data (r^2 = 0.94, Figure 27). The latest assessed stock abundance for 1991 was projected forward to 1994 by removing scallops at current F and recruiting scallops with a log-normal distribution.

The mean levels of predicted yield from 1000 iterations with log-normal, variable recruitment, are the product of an average level of recruitment through the period. That is, recruitment prior to the predicted year was variable, but approximated the average of historic recruitment. The yield projections for no action (status quo), the non-preferred alternative (3 -> 3.5" Rings), and the preferred alternative (3.25 -> 3.5" Rings) are presented in Figures 28 and 29 for current F at 2.25 and 1.50, respectively.

Both estimates at different current Fs have the same form, only the absolute level of predicted landings and only the relative difference between alternatives changes. During the first year of implementation, yields are predicted to be 18 to 23 million pounds. Small increases in yield compared with status quo management are expected because of increased landings of small scallops. This increase is expected because of the removal of the meat count which is replaced by 3¼ inch rings and marginally higher F (preferred). The non-preferred alternative (3" rings) is expected to allow a significant increase in the harvest of small scallops despite the reduced fishing mortality (1.43 vs. 1.50).

The yields for the status quo decline rapidly to an equilibrium level predicted from current fishing mortality and partial recruitment. At F=2.25, it declines to 16.4 million pounds, 18.3 million pounds when F=1.50. These projections are considerably below the long-term potential catch (29 million pounds) calculated by NMFS (1992a), but the proposed management measures are significantly different than an optimal harvesting strategy that maximizes yield. F_{max} is calculated to be approximately 0.19 at the current age at first capture (age 3 partial recruitment = 0.24). It is also slightly below the 32 year average of 19.9 million pounds since 1960 (Figure 2).

For both management alternatives, the projected yields decline substantially through year 3 (1996). The yield loss due to changes in gear restrictions from 3¼ to 3½ inch rings is considerably less onerous than switching from 3 to 3½ inch rings. This difference occurs because the use of 3¼ inch rings delays harvest of small scallops during the first two years. The delay makes more scallops of harvestable size available to 3½ inch ring dredges than would occur if the first two years fishing were conducted with 3 inch rings. With the preferred alternative (3¼ inch rings), stock abundance increases and older scallops become more predominant by year 3.

Beyond year 3, yields for both alternatives are projected to rise above the equilibrium level for the status quo to 21.5 million pounds. In year 4, the preferred alternative is expected to have marginally higher yields than the 3" -> 3½" option. The differences between the two ring size options are subsequently insignificant.

These projections can and were calculated for any level of recruitment. When calculated so that future status quo yields approximate current landings (Figure 27), all three cases exhibit the same form as described above. Equilibrium yield is approximately 35 million pounds for the status quo. It reaches almost 40 million pounds for the target fishing mortality (0.97) with 3½ inch rings. Coincidentally, to obtain these equilibrium yields at those fishing mortalities, recruitment above the 95th percentile of past recruitment is required.

Because it is impossible to predict precise levels of future scallop recruitment, the yield projections were compared with the status quo at various recruitment levels. Four levels, low, average, high, and very high are presented in Figures 30 and 31. The very high recruitment outcome simulates the conditions of peak abundance and landings experienced during 1990-1992. For the preferred alternative (3¼ inch rings in years 1 and 2, Figure 30), the yields in year 1 (1994) are not significantly different from No Action (0% in Figure 30) regardless of future recruitment. Because very high recruitment would produce a high abundance of small scallops in year 1, increased landings of small scallops would be expected under continuation of the meat count and current fishing mortality rates. Otherwise, higher yields would be generated from the higher fishing mortality under the preferred alternative (1.56 vs. 1.50). These yields decline to 8-18 percent below No Action by year 3 (1996). The expected declines in yield are exacerbated by low recruitment, i.e. the largest decline occurs when recruitment is low. After year 4, yields are projected to be slightly higher than No Action. Yields are predicted to increase to between 12 and 22 percent above No Action because stock abundances are higher and no reductions in F are scheduled. At equilibrium conditions (2005 to 2008), future yields are predicted to be 18 to 37 percent above the status quo. The highest difference in yields generally occurs when recruitment is low (18 vs. 14 percent).

A similar pattern is evident for the non-preferred alternative having 3 inch rings in years 1 and 2, except that the changes in yield are significantly more negative in year 3. Yield initially increases to 7 to 9 percent above status quo yield (0%, Figure 31). When the gear restrictions would change from 3 to 3½ inch rings, the yield is expected to decline to 24 to 29 percent below status quo. It is expected to become marginally positive in year 4 and increase to equilibrium levels once the effort reduction program reaches its target. At this point, the yields are projected to increase to 14 to 18 percent above status quo at equilibrium (2005-2008).

Catch per unit effort (CPUE) is expected to increase significantly through effort reduction (Figure 32). Very little change in CPUE (i.e. catch per vessel-day at sea) is expected in the first three years. Slight declines in yield relative to the status quo (0%) can be expected in year 3 (1996), when 3½ inch rings are required. CPUE increases to 80 percent above status quo conditions if current F is 1.50. When current F is 2.25, a 57% reduction in effort is necessary, and CPUE rises to 200 percent above what would be expected under No Action.

3. Cost-Benefit Analysis

The proposed action will have economic impacts on the producers as well as on final consumers. The decrease in the fishing effort is expected to reduce the variable costs of vessel operation and increase income of vessel owners and crew. On the other hand, the expected reduction in the yield during 1995-1997, and the subsequent increase in landings will have direct impacts on the fishermen's revenues as well as on consumer benefits through changes in the scallop prices. In the next section, various approaches to estimating scallop prices will be discussed, and a single equation model of the scallop ex-vessel price is described. Following a historical validation of the model, estimated scallop prices and revenues under No-Action and effort-reduction scenarios are examined (section VII.F.3.a). Cost structure of the scallop fishing industry is presented in section VII.F.3.b. Section VII.F.3.c, on the other hand, investigates the potential for cost savings. These individual impacts are combined in section VII.F.3.d to estimate the net benefits of the management action. The effects of the management measures on labor income and profits is discussed in section VII.F.3.e using various assumptions about the lay system. A sensitivity analysis for assumptions about import prices is given in section VII.F.3.f.

a. Price Model

The proposed reductions in fishing effort (and the resulting changes in landings) affect producers and consumers through changes in the price of scallops. Various approaches have been used to model scallop prices, ranging from multi-market models at the ex-vessel, wholesale and retail level to simultaneous estimation of the domestic demand, price and quantity of imports.

A multi-market model of the scallop industry was developed by Wang, et al. (1986) which provided a set of equations to describe scallop markets, production, and fishing effort. Since the original models were estimated, however, the necessary data is no longer available. The specification included three market levels; ex-vessel, wholesale, and retail. Since 1981, Chicago king crab prices have been discontinued and king crab was used as a substitute good in the model. Moreover, the Baltimore retail prices and Boston wholesale prices for scallops have also been discontinued since 1981. Thus those market levels can no longer be specified.

The following price model estimates ex-vessel price of sea scallops during 1976-1992 as a function of domestic landings, import prices, time trend and a dummy variable. The time trend variable is used as a proxy for exogenous changes which include increases in disposable income. A dummy variable reflects the influence of structural changes in the scallop markets since 1983, i.e., an increase in the demand for scallops as reflected by an upward shift in prices and a nearly quadrupled import volume from countries other than Canada.

The main objective of demand estimation for scallops is to determine how the prices would change as a function of yield during 1994-2008. The model, therefore, only includes those explanatory variables whose future values can be reasonably projected. The import price of scallops, a variable which is difficult to forecast, could not be excluded from the demand equation because of its relationship to domestic ex-vessel prices. Other regression experiments which do not include import prices have produced poor estimation results, i.e., poor fit to the past values of actual ex-vessel prices. Also, inclusion of the import prices made it possible to estimate the range of expected net benefits under various assumptions about future import prices. Future import prices were a major concern of various fishermen and dealers during public hearings.

Ex-vessel and import prices (Figure 33) were very close until 1983. Although these prices followed a similar trend after 1982, ex-vessel prices, in general, exceeded the import prices during 1983-1992. This occurred because of structural changes in the import market which was dominated by Canada until 1983, but later included other countries such as Peru and China. The imported sea scallops from Canada are similar to domestic scallops and therefore commanded higher prices than scallops from other countries.

The most striking change that took place in the scallop market was the influx of less-expensive (possibly small-sized scallops) from countries other than Canada since 1983. According to the New York Market News Report (NMFS 1993), imports from Peru with a 40/60 and 60/80 meat count had a price of $3.85 and $3.35, respectively. The price of imports from China with a 40/60 meat count were $3.50. On the other hand, the meat count for domestically landed sea scallops ranged from 10/20 to 30/40 and had corresponding prices of $5.50 and $5.15 per pound.

Annual imports from these countries averaged only 5 million pounds during 1976-1982. The imports from other countries subsequently increased to 20 million pounds and have since been well above 15 million pounds. One factor causing this change could be the meat-count standards adopted by the U.S since 1983, which possibly resulted in a higher quality product compared to imported scallops. This standard probably created a new market for small-sized imported scallops. Another important factor may be an increase in the consumer preference for scallops in general. Total sea scallop supply increased from 50 million pounds annually in the late seventies to 70 million pounds in the last four years

(Figure 34). The establishment of the "Hague Line" was a critical change that took place in mid 1980's. This separation of the U.S and Canadian fishing grounds directly affected ex-vessel prices.

Empirical results and model validation

The best estimation of the ex-vessel scallop prices during 1976-1992 is given by the following equation:

Equation **(1)**

STACK {P~=~0.31~-~0.0496 Q~+~0.0452 T~+~1.1063 I~+~0.8424 D # ALIGNL t_stat :~(0.4)~~~(-3.06)~~~~~(1.04)~~~~~(10.19)~~~~(2.22)}

where: P = Ex-vessel price of scallops in 1990 dollars
Q = Landings (million pounds)
I = Price of imports in 1990 dollars
D = Dummy variable, D=1 after 1982
T = Trend.

$R^2_{adj} = 0.91$ DW = 1.44 N = 17

A similar model based on quarterly data produced similar results, but quarterly yield estimates are unavailable and the seasonality of fishing is likely to change. An annual model, therefore, is used to forecast prices for 1994-2008 given the annual level of landings under no-action and various management alternatives.
The estimated prices based on the ex-ante simulation of this model are depicted alongside with actual prices in Figure 35. These prices show good correspondence and forecast errors given in Table 27 are low. A limitation of this mode, however, is that it does not consider the effects of domestic prices and landings on import prices. It implies that the import prices are exogenously determined (from the supply-side) regardless of the level of domestic demand and prices. Obviously, a more complicated model is needed to estimate the determinants of import prices, such as the potential capacity of the exporting countries, i.e. the level of their landings, scallop prices in other countries, variable and average costs of fishing, total U.S. demand for scallops, etc.

The projected landings from the yield model (mean recruitment) are used by the economic model to predict the ex-vessel prices for the no action and effort-reduction alternatives. Figure 36 shows the estimated prices and annual revenues with current fishing mortality equal to 1.50. As expected, prices move opposite to landings. They are higher for the preferred (3¼ inch ring) and non-preferred alternative (3 inch ring) in the early years and lower than no action after 1998. Import prices, in this case, are assumed to stay constant at 1992 levels. Sensitivity analyses (section VII.F.3.f) test the overall response to this assumption.

Ex-vessel revenues for the scallop fleet are calculated from expected landings and prices. Revenues follow the same pattern as landings, but are dampened by prices. Figure 37 shows that revenues decrease below no action from 1995 to 1997 because of reduced landings. After 1998, revenues for both the preferred and non-preferred option exceed the revenues under No Action alternative due to the increased landings.

b. Cost structure of the scallop fishing industry

The cost and earnings data are obtained from two sources. University of Rhode Island (URI) data (John Gates, pers. comm.) contain fifty-five observations on the main cost items of the scallop dredges for 1983 to 1990. Data supplied by NMFS (Stanley Wang, pers. comm.) contain twenty-nine observations for 1989 to 1990. This data is characterized in Tables 28 and 29.

i. Variable costs

Variable costs are expenses which are proportional to fishing effort, e.g. fuel, oil, water, ice, repairs, captain, and crew compensation. They are treated in three categories: a) operating (non-labor) expenses, that is fuel, oil, water, and ice; b) non-wage variable costs including repairs and food expenses; and c) total variable costs, that is operating costs including repairs, food, crew shares and salaries.

Operating expenses, (excluding repairs), on the average, comprised 18 percent of the gross stock in 1990 (Table 30). Repairs are considered to be semi-variable costs. When food expenses and one-half of the repairs are added to these expenses, average non-wage variable costs were approximately 26 percent of the total revenues from landings in the same year. More presently, these expenses have increased as a proportion of gross revenues.

The URI data contain fifty-four observations which include labor expenses as a cost item, whereas the NMFS data is composed of twenty-nine observations but lack information about the crew share and salaries. In order to include those thirty observations in the calculation of variable and total costs, a rough estimate of wages and salaries was obtained based on a regression analysis of the URI data.

Since crew compensation generally depends on a percentage of the gross stock (B) minus operating expenses such as food, fuel, oil, water and ice expenditures (S), crew income (including salaries) was estimated as a function of these variables during 1983-1990 as

Equation **(2_**

STACK {C~=~0.609B~-~0.988S # ALIGNL t_stat:~~(1.15)~~~~(32.19)}
follows:

where: C = Crew shares and salaries
B = Gross stock
S = Supplies, e.g. food, fuel, ice, and water

$R^2_{adj} = 0.99$ N = 54

There is no intercept term because it was not significant. The value of R^2 was similarly high (0.97) when the intercept was included in the equation. No explanatory value is attached to this equation since it is based on the definition of lay system itself. It is simply used to obtain an approximation of the crew share and salaries for the missing observations. Although crew shares are determined by different lay systems at different ports they result in almost equivalent wages when the proportion of common expenses in gross stock is about 20%. This equation replicates the share system most widely used by New Bedford scallopers, where crew members receive 60% of the gross stock and pay expenses for the fuel, food, ice, etc. These estimates were combined with the observed crew shares and salaries in the URI data and added to operating expenses to calculate total variable costs. Variable costs including food, crew share and salaries, on the average, comprised approximately 70 percent of the gross revenues (Table 31).

ii. Fixed costs

Fixed costs are expenditures (such as interest, depreciation, administration expense and insurance) that are incurred regardless of the amount of fishing effort. A comparison between various fixed costs and gross revenues is given in Table 32.

iii. Total costs and profits

Variable and fixed costs are summed to calculate total costs. The composition of costs as a proportion of total costs is presented in Table 33. Variable costs including crew shares comprise, on average, about 70 percent of gross stock and 76 percent of total costs (including depreciation). Average profits before depreciation and taxes constitute around 7 to 8 percent of the gross revenues (Table 34). These ranges are large and may be due to several factors such as differences in vessel sizes, the captain's skill, proximity to fishing grounds, and data inaccuracies.

c. Cost savings

The category of costs that are most relevant for the analysis are those expenses that are proportional to fishing effort, such as fuel, oil, water, ice, repairs. These non-wage variable costs (including food, and one-half of repairs), comprised about 26 percent of the gross revenues in the scallop fishery (Table 30). Real scallop revenues is estimated to be about $ 145.9 million in 1990 prices. In order to obtain a cost value consistent with this level,

nonwage variable costs (fuel+oil+ice+water+food+1/2 repairs) are estimated to be 26.3% of $ 145.9 million, that is, $38.4 million in real prices for the no-action scenario.

No savings to the economy through reduced labor costs are expected, since in the absence of alternative employment, the opportunity costs of labor does not change. If other employment opportunities to the fishermen do not exist, then any reductions in labor expenses to a fishing vessel will still be a cost to the economy. However, the changes in expected crew wages and salaries, that is changes in economic rent to labor, are examined later in section VII.F.3.e. As pointed out by Kirkley and Dupaul (1993), in the absence of alternative employment possibilities to fishermen, the opportunity costs of labor are very low, and this means that labor earns an economic rent. They also indicate that there is some evidence suggesting that vessel captains and crew earn considerable rent from scalloping. It is also assumed that there will be no change in the duration of trips, and that the variable costs will decrease in the same rate as the planned reductions in fishing mortality and days at sea.

Proposed effort reductions at various current fishing mortalities are given in Table 35 for preferred (3-¼ inch ring) and non-preferred (3 inch ring) alternatives. When current fishing mortality is 1.5 , the fishing mortality and days at sea limits are estimated to increase by 4.2 % in 1994, and to be reduced by 6.7% in 1995 and 1996, and thereafter by an additional 9.5% as compared to the base-year (1990) total fleet days at sea (48,253) for the preferred alternative. By year 2000, total days at sea will be 35.3% less than the 1990 total fleet days. By applying the same proportional reductions to the base-year non-wage variable costs, the nominal value of these expenses are estimated for 1994-2008. A preliminary regression analysis of the non-wage variable costs provides some evidence about the proportionality assumption, i.e. variable costs decrease in the same proportion as the days at sea, since its coefficient is almost unity:

Equation **(3_**

STACK {ln V~=~-1.02~+~1.47~ln G ~+~1.01~lnE~-~0.09~lnL~+~0.02T # ALIGNL t_stat:~~~(-0.5)~~~(3.5)~~~~~~~(8.3)~~~~~~(-0.7)~~~~~~~(0.7)}

where: V = Variable costs excluding labor
G = Gross registered tonnage
E = Days at sea
L = Trip length
T = time trend ranging from 1 to n, where n is the number of annual observations

$R^2_{adj} = 0.71$ N = 51

The effort reduction alternatives also require the mandatory and continuous use of transponders for full-time scallopers as well as a change in the dredge ring-size (in years

one and three for the preferred alternative, and in year three for the non-preferred alternative). For these reasons, the cost of transponders and the new rings were included in the expenses to compute net cost savings compared to the No-Action alternative. The cost of buying transponders is assumed to be $3.75 million in 1993, the average of the upper ($6.2 million) and lower ($1.3 million) estimates for the fleet (Table 24). Similarly, the cost of maintaining transponders in the subsequent years, on the average, is estimated to be $1.85 million. Cost of new rings, on the other hand, is expected to be $580,000. These costs are deducted from cost savings and were converted to real dollars (1990 prices).

Because of the estimated increase in effort in 1994, cost savings for the preferred alternative are negative in the first year (Figure 38). Due to the planned reductions in effort after 1995, non-wage variable costs decrease as compared to no-action levels. As a result, annual cost savings reach $12 million annually after 1999. The annual cost savings for the non-preferred alternative exceed those of the preferred alternative until 2000. This occurs because the scheduled reductions in fishing effort are greater for the non-preferred alternative to compensate for harvesting smaller scallops with the smaller 3-inch rings.

For the preferred alternative, the cumulative savings in non-wage variable costs ranges between $51.9 and $95.5 million (10% discount rate) and ranges between $78.6 and $141.0 million (5% discount rate) for various current assumptions about the base fishing mortalities (Table 36). To re-emphasize, the actual cost savings could differ from these values if there is a change in the number of trips that vessels take annually. Analyses for the adjustable layover day alternative (section VI.G.3) suggest that some scallop vessels will extend fishing trips to increase profitability. If true, non-wage cost savings will exceed these estimates (Figure 38), since fuel expenses will most likely decrease as a result of longer but less frequent fishing trips. Conversely, overall cost savings could be less than the adjustable trip limit alternative (section VII.F.1.c). With trip limits, scallop vessels may be forced to shorten their trips and consequently to take more trips to maximize their landings. (see section VII.F.1.d).

d. Net benefits

Estimated cost savings are combined with the price projections to estimate total net benefits of the proposed action. Net economic benefits (Figure 41) include the change in consumer surplus, plus the change in revenues, plus the savings in non-wage variable costs. In other words, net economic benefits defined as the sum of consumer surplus plus the producers' surplus (real values in terms of 1990 prices). If the net benefits are estimated in terms of 1992 dollars for example, the net benefits (in 1992 dollars) would be higher than those presented in this section. Also, the net benefits are calculated by assuming that import prices will stay constant at their 1992 level.

Changes in net revenues are expected to be negative for the preferred alternative during

1994-1996 (and close to zero in 1997) as a consequence of decreased scallop landings (Figure 39). For the non-preferred alternative, net benefits are positive in the first year since expected landings exceed the No-action levels which result in higher revenues and higher consumer surplus. In 1995 and 1996, net benefits become negative because of the sharp declines in revenues, a $25 million net loss for the non-preferred option in 1996 compared to $15 million net loss for the preferred alternative. In fact, the net loss for the non-preferred option could be much larger than predicted. The size of scallops will be smaller with a 3 inch ring dredge than captured by a 3¼ ring dredge. Because the price model could not take lower prices for smaller scallops into account, revenues for the non-preferred alternative during 1994-1997 are overestimated.

After 1997, the annual net benefits will be positive (Figures 39 and 40) as cost savings from reduced fishing effort accumulate and as revenues increase through higher landings and / or higher prices. Annual net benefits reach $30 million for F = 1.50 and $50 million for F = 2.25 in the early 2000's. Cost savings comprise most net benefits until 2002. Subsequently, increase in revenues comprise approximately 50 percent of the net benefits. Cost savings contribute 40 percent of net benefits and consumer surplus contributes the remaining 10 percent. The annual composition of net benefits is summarized for the preferred alternative in Figure 41 and the non-preferred alternative is summarized in Figure 42.

Tables 37 and 38 summarize the value and the composition of net benefits for different discount rates. The present value of cumulative net benefits are positive for each case. Over 1994-2008, the present value of the net benefits of the effort reduction varies between $99 to $175 million if the discount rate is 10%, depending on the ring size and the assumed base fishing mortality rates. They vary between $160 to $272 million if the discount rate is 5%. The actual benefits could differ from these values if fishing behavior, duration and number of trips, etc., changes. In addition, the cost savings may be underestimated because they do not include potential reductions in other cost categories such as gear and supplies, accounting and legal costs, insurance, etc. Finally, if scallop vessels are used in other fisheries, fixed costs should be apportioned between scalloping and other fishing. Treating fixed costs in this manner would further increase the cost savings from the management program. Because it is not possible to anticipate the extent of other fishing, this analysis again underestimates economic benefits.

The present value of cumulative net benefits is slightly larger for the non-preferred alternative compared to preferred alternative (Tables 37 and 38). As explained above, net benefits in the first year were positive for the non-preferred option but negative for the preferred option. Although the revenues decline sharply in the following two years for the non-preferred option, the discount rate heavily weights the first year`s benefits. In fact, if the first year is ignored and the cumulative present value is calculated for 1995-2008, cumulative net benefits of the preferred alternative ($101.2) would slightly exceed those of

non-preferred option (98.9) for the base fishing mortality case of 1.50. The results are similar for other base fishing mortality assumptions, i.e. net benefits for the 3¼ inch ring option are larger than that of the 3 inch ring option for the period 1995-2008. Also, actual revenues for the non-preferred option probably will be less than the predicted revenues due to a change in the composition of landed scallops to include smaller sizes.

e. Profits and labor income

i. New Bedford lay system

The cost-benefit analysis presented so far does not include the savings in labor expense because it is assumed there are few alternative employment opportunities for the fishermen. The opportunity costs of labor to the society, therefore, remain the same under effort-reduction alternatives as compared to no action. From the perspective of the industry and the crew members, however, it may be useful to analyze the likely impacts of the proposed actions on the monetary value of crew shares rather than on the opportunity costs of labor.

Crew income is difficult to estimate because the lay system changes not only from port to port but also from vessel to vessel. Future lay systems are also uncertain. Under the New Bedford lay system, crew members receive approximately 60% of the gross stock and pay for the operating costs such as fuel, food, ice, water and oil expenses. The change in the relative shares of crew wages and profits were further investigated by using two other variants of the predominant lay system.

Figure 43 shows the change in annual labor incomes as compared to No Action, assuming that crew wages and salaries are determined by New Bedford share system. For the preferred alternative, the percentage change in annual crew shares as compared to no-action level is almost zero in 1994, negative in 1995 and 1996 and positive after 1996 (F=1.50, New Bedford lay system). These results imply that estimated value of the crew share and salaries declines in 1995 and 1996 as compared to the status-quo, and exceeds the no-action levels beginning in 1997. The decline in 1995 and 1996 is attributable to decline in gross revenues and the increase after 1996 is a result of higher revenues as well as the decline in the operating expenses usually paid by crew.

To estimate the net change in industry profits, the net change in total variable costs, including labor costs, are deducted from the change in the total revenues.[3] The estimated

[3] The net change in the total variable costs as compared to no-action values (fuel + ice + water + oil + food + crew wages and salaries) is negative which represents cost savings from reduced fishing effort. Deducting this negative amount from the change in total revenues is equivalent to adding net cost savings to the change in revenues.

change in the annual gross profits compared to no action levels is negative during 1994-1997, close to zero in 1998, and positive after 1998 (Figure 44). However, this is a minimum estimate of the change in profits since it relies on a standard New Bedford lay where food, fuel, water and ice are paid for by the crew. Accordingly, the crew receives all the savings in operating expenses while the industry profits change in direct proportion to revenues.

Table 39 summarizes the present value of the change in the labor incomes and profits using a 10% discount rate. The increase in the cumulative present value of the crew share and salaries for 1994-2008 varies between $83.1 to $134.1 million, depending on the particular ring-size and current fishing mortality. The cumulative increase in the present value of profits ranges between $7.5 to $22.2 million for 1994-2008. These values are lower than the net benefits received by crew members. According to this lay system (New Bedford), operating expenses are paid out of crew shares and salaries, and the savings associated with these costs accrue to the crew members. Under a share system which divides the net stock(gross stock net of operating expenses) between crew and the vessel owners, the increase in gross profits will be higher and the increase in crew wages will be lower than presented in Table 39. Since the future changes in the share system cannot be predicted, the magnitude of the estimated economic benefits captured by crew members and vessel owners indicate the upper and lower limits of the possible benefits rather than the actual values. If vessel owners attempt to cut down on labor costs and other expenses which are not taken into account, the net impacts of the management measures on industry profits will exceed those presented in Table 39.

ii. Other lay systems

Although the estimated net benefits (the sum of consumer and producer surplus) are independent of the lay system, the distribution of benefits between labor incomes and profits will vary according to the institutional arrangements regarding crew shares. Under the New Bedford lay system, labor incomes will increase considerably after 1999 and exceed the No Action level by 70% (Figure 43). However, this may be an unrealistic outcome since it implies that labor will receive all the savings in costs and a higher share of gross revenues despite the reduction in effort (days at sea). Two additional experiments were conducted using the variants of the current lay system: a) Crew wages and salaries are determined by a 40/60 split of the gross stock, and b) by a 50/50 split of the net stock. In 1989 and 1990, the share of crew wages and salaries were approximately 40 percent of gross stock. When the share of joint expenses is about 20% of the gross stock, a 40/60 split of gross revenues between crew and vessel owners produces labor income equivalent to New Bedford lay or a 50/50 split of net stock. However, as the days at sea and therefore joint expenses are reduced, these three lay systems will produce different results during 1994-2008.

Perhaps a more realistic assumption would be to determine the labor incomes as a constant

proportion of gross stock. Figure 45 shows the percentage change in wages and salaries if crew shares are determined by 40 percent of gross stock during 1994-2008. It implies that all the savings in variable costs accrue to the vessel owners, the opposite of the New Bedford lay system. As a result, the change in crew wages compared to no action levels is lower than before, both in the earlier years of decline (12% decline in 1996 compared to a 20% decline for the New Bedford lay system) as well as in subsequent years (a maximum increase of 15% per year as compared to 70%).

The same system produces a larger change in industry profits, especially after 1997. Industry profits increase drastically as cost savings and revenues increase. Figures 44 and 46 show that the profits increase annually by $20 million in the later years of the program as compared to an annual increase of $6 million under the New Bedford lay system.

Although it is possible to examine an unlimited number of scenarios based on different lay systems, the two lay systems analyzed above provide a reasonable range of changes in labor income and profits. Since the New Bedford lay implies that all cost savings are received by crew, it provides the maximum expected increase in crew shares and minimum increase in profits. A lay system based on 40/60 split of gross stock assumes just the opposite, i.e. vessel owners would receive all the savings in costs. It results in a less optimistic increase in the crew shares and a higher increase in profits. Another lay system, a 50/50 split of the net stock, is also used to determine crew shares by some New Jersey as well New Bedford vessels. Since this system is based on the distribution of net stock, i.e. gross stock minus the joint expenses, it distributes cost savings and change in revenues almost equally between the crew and the vessel owners. The outcomes of these three systems are summarized in Table 40 with current F=1.50 and 2.25. The results show that the impacts of effort-reduction (preferred alternative) on labor income and profits is positive although the distribution of the benefits change according to the assumed lay system.

f. Sensitivity of the net benefits to import prices

The cost-benefit analysis assumed that import price of scallops remained constant during 1994-2008. Under these conditions, ex-vessel prices are expected to increase when landings are reduced. This increase in price dampens the negative effect of reduced landings. In the later years, price increases less drastically because of higher scallop supply and this slowing of price increases has a beneficial effect on consumer surplus. Overall, both of the effort-reduction programs produce increased revenues for the fishing industry, lower costs, and higher consumer surplus. However, since the future trend in import prices is uncertain, there is reason to be concerned about the expected impacts if the price of imported scallops declines.

Table 41 shows that import prices (in 1990 terms) were not constant during 1977-1992,

perhaps with the exception of late seventies and early eighties. During 1977 to 1985 when the domestic landings declined, the average annual change in import prices was very small (about 0.7% increase). The second period (1986-90) on the other hand, corresponds to a period of increased domestic landings and imports, with a 7.5% decline in domestic and 4.5% decline in annual import prices. This declining trend in import and ex-vessel prices seems to have reversed after 1990, and parallels the decline in domestic landings (Figures 33 and 35).

Table 42 shows the results of several experiments with various assumptions about the import prices for the preferred alternative with low (1.50) and high (2.25) current fishing mortality. The results of the previous analysis with constant import prices are replicated in the Table 42 for comparison (experiment I).

The second experiment assumes a 5% annual decline in import prices for 1994-2008, which is close to the average annual decline in the period 1986-90 (4.5 %). This reduction dampens the increase in ex-vessel prices. As a result, the revenues tend to increase less than as compared to experiment 1. The change in the consumer surplus (Table 42) remains the same despite the decrease in import prices. Since import prices are assumed to be determined exogenously, they are independent of domestic landings and, therefore, have the same value (decreased by 5% each year) in the No Action and effort reduction alternatives. Although ex-vessel scallop prices change following a change in import prices, the difference between the ex-vessel prices under various scenarios remain the same. Since the change (or difference) in the consumer surplus is a reflection of the change in the prices, its value does not change when import prices change. Cost savings also remain unaffected by a change in import prices. The overall effect, however, is still positive; the present value of the change in revenues is $21.5 million for current F=1.50, and $34.9 million for current F=2.25. Since costs savings and the change in the consumer surplus also remain positive, changes in net benefit are estimated at $81.9 million for F=1.5 to $142.9 million.

The reversal of the trend in ex-vessel and import prices after 1990 indicates that import prices probably will continue to increase in 1994-2008, since reduced domestic landings may lead to an increase in the demand for imported scallops. For this reason, a third experiment assumes a 5% annual increase in real import prices, a modest increase as compared to 7.9% increase in 1991-92. The estimated revenues and net benefits are positive as expected; the present value of the change in revenues is $ 68.3 for current F=1.50 and $105.2 million for F=2.25. Net benefits reach $128.8 to $213.2 million for F=2.25 at a 10% discount rate.

Experiments II and III assume that the change in import prices are the same under both no action and effort-reduction alternatives. Of course, this may not be a realistic assumption. Historical data (Table 41) indicates that import prices more or less reflect the fluctuations in domestic landings and prices. If instead of being exogenously determined the change in

import prices could follow the changes in ex-vessel prices, then ex-vessel prices would be more responsive to changes in the landings. An example of a simple model which takes into account the affect of domestic prices on import prices is:

Equation **(4_**

STACK {P~=~1.54~-~0.0547Q~+~0.0061T~+~0.9518I~+~0.9047D # ALIGNL t_stat:~(1.2)~~~(-4.05)~~~~~(0.15)~~~~~(4.78)~~~~~(3.04)}

R^2_{adj} = 0.91 DW = 1.48 N = 16

Equation **(5_**

STACK {I~=~1.92~-~0.87D~+~0.55P~+~0.10I_{t-1} # ALIGNL t_stat:~(2.8)~~(-2.96)~~~(2.29)~~~(0.44)}

where: P = Ex-vessel price of scallops in 1990 dollars
Q = Landings (million pounds)
I = Price of imports in 1990 dollars, t-1 represents lagged variable
D = Dummy variable, D=1 after 1982.

R^2_{adj} = 0.75 Durbins H = 1.08 N = 16

This model combines the same ex-vessel price equation with an import price equation. It is estimated by a two-stage least squares method. For that reason the coefficients are different than the single equation model. Although this model provides a reasonable fit to the actual values of ex-vessel and import prices, it has not been taken as the base model because: a) the import price equation ignores many possible determinants and it is at best considered as a rough feedback model, b) the single equation model provides a better fit to ex-vessel prices, and c) the single equation model makes it possible to experiment with different trends in import prices, whereas with the two equation model, a unique solution for import prices is obtained.

The results of the cost-benefit analysis based on this two-equation model (experiment IV) are shown in Table 42. Since this model allows import prices to change under effort-reduction alternatives as compared to no action case, the change in revenues ($29.3 to $48.6 million) is less than it would be if import prices remained the same under each alternative. The change in the consumer surplus will be higher ($21.9 to $31.9 million) than in experiments I, II and III because of the increased responsiveness of prices to landings.[4] The

[4] The experiment with a 5% annual decline in import prices shows the case of an opposite response in import prices to the change in ex-vessel prices, i.e. although ex-vessel prices are likely to increase as a result of a decrease in landings (and later as a result of a positive trend), import prices continue to decrease.

present value of the overall net benefits is estimated to be $103.1 to $176.1 million. Incidentally, this result is very close in value to the case of constant import prices.

In summary, the results show that, even if import prices decline continuously (5 percent annually) in the next fifteen years, the cumulative net benefits will still be significantly positive under the effort-reduction alternatives compared to no action. An increase or a change in the import prices in the same direction as ex-vessel prices will magnify the net benefits of the proposed actions.

g. Summary

The reductions in fishing effort will substantially reduce operating costs compared to the No Action alternative. Cost savings will augment increases in expected revenues and consumer surplus (Figures 41 and 42). Import prices and different lay systems have limited effect on this outcome, although the distribution of benefits may change. The range of net benefits should be interpreted with caution due to uncertainties about the likely changes in fishing behavior, fixed costs, import prices, and the share system, etc. Despite these uncertainties and the limitations of the analysis, the results suggest that after the first three years, annual net benefits associated with the proposed management options will be positive compared to no action under various assumptions about the import prices and lay systems. This produces a positive net benefit, in terms of cumulative present value for the effort reduction alternatives when the annual net benefits are summed and compared with the no action values.

G. Social Impacts

No other material within the SEIS gives a detailed description of the social aspects of the fishery, and therefore they are summarized from the Social Impact Analysis. Brief descriptions of local communities and the potential for impacts on ethnic groups, employment, and small business is given below.

1. Communities

Although the greatest change in scallop revenues will occur in the largest ports, New Bedford, Cape May, and Hampton-Norfolk, these ports have other opportunities for temporary and long-term employment. Scallopers from these ports have more flexibility to pursue other fisheries and fish other scallop grounds.

The largest social impacts will occur in small, isolated communities with local fleets. Income from fishing is very important to families within these communities. As Acheson (1988b) makes clear that families, both nuclear and extended, are important economic units

with common occupational activities among kinsmen. Hence if fishermen are unemployed, the effect would extend beyond their immediate families to extended kin networks.

Family firms such as those in coastal ME are a key aspect of what economic anthropologists refer to as "petty commodity production", in which family labor is redistributed "among a similar class of household undergoing cyclical variation in labor availability" (Russell and Poopetch 1990). Family fishing firms have "shock-absorbing" capabilities which protect their economic well-being and their communities (Lofgren 1972). People in a diversified economy deal with risk and develop very rapid responses to unpredictable resource fluctuations. Family units enable people to do this very effectively with very low capital investments and reserves (John Bort, pers. comm., October 1992).

Because economic, kinship, political and religious subsystems are more closely interwoven in rural rather than in urban communities, any actions which lead to disruption of small-scale industry in rural communities will adversely affect the entire function of the rural culture (Guyette 1992). Two areas that fit this description are the coast of ME, especially east of Portland, and Chatham, MA.

a. Coastal Maine

These communities that depend on scalloping are very small. Lubec and Stonington have populations considerably fewer than 1,000 people. Even the larger towns where scalloping occurs are fairly small. Rockland has fewer than 8,000 people. Fishing in ME is predominantly "small-scale" (Pollnac 1985), but the technology may be less relevant to social impact, than certain aspects of economy and culture. Employment opportunities along the coast east of Portland are scarce. The only notable industries are fishing and tourism (Acheson 1988b). Fishermen generally have few skills or resources which would allow them to work in the tourist industry should the fishery fail. Furthermore, working as an employee, rather than being self-employed is scorned (Acheson 1988b).

ME fishermen claim their catches are not adequately documented, prohibiting them from qualifying for a permit under the moratorium. Similar claims were heard elsewhere among small boat scallopers in MA, in NJ, and in NC. NEFMC data support their claim. More pertinent to the distinctive social and cultural situation in coastal ME is the fact that the resource is also distinctly different from the resource elsewhere in the Atlantic. The Sea Scallop FMP (NEFMC 1982) notes that productive beds of scallops have "suddenly developed" in the Jeffreys Basin/Cashes Ledge area of the Gulf of Maine. ME landings comprised only 5.6% of the total U.S. scallop landings. In 1977, it provided only 2% (Serchuk et al. 1979). At its peak, it added 13% in 1980, due to landings from Jeffreys Ledge. Peaks in localized abundance may be due to infrequent recruitment of spat into local waters when currents and conditions are favorable.

This has specific bearing on whether boats should be locked into low harvest capabilities when larger harvest have traditionally been available on a periodic basis during resource "booms." The relative insignificance of this should be carefully balanced against the substantial social impact on ME scallopers.

b. Chatham, MA

Chatham is not nearly so isolated, but the tiny scalloping community of less than two thousand people is nonetheless removed from sizeable urban centers. Hyannis, with a population of about 10,000, is the only sizeable town on Cape Cod. Fishing is a major commercial activity in Chatham. During good years, scalloping reportedly brought $10 to $12 million into the local economy.

Chatham scallopers are in a situation similar to that of scallopers in coastal ME. They explain that two factors preclude them from the fishery under moratorium First, local scallops have been available intermittently. Second, those scallops which are regularly available within the range of Chatham boats have been caught by New Bedford boats loading up with undersize scallops before going further offshore to get larger "mixer" scallops.

Chatham boats largely rely on cod, when available. One alternative to cod has been the quahog fishery (Dewar 1983). When scallops are available, nearly all of the boats switch over to scalloping making Chatham what locals call "a port of opportunity". Local boats caught 1,000 or 2,000 pounds per day when legal scallops were within range.

There reportedly have been four peaks in local scallop abundance since 1978. One large peak lasted from 1976-1979. During the latest peaks, however, the meat count regulations were in effect and large New Bedford boats harvested this resource and then moved on to mix scallops from distant grounds. There were no legal scallops near Chatham during 1988 or 1989. As a result, many local boats did not scallop and, therefore, will not qualify under the proposed moratorium (Pollack 1991b).

If small boats from local communities are uneconomic under the 400 pound by-catch limit and they qualify for very few days at sea, when scallops become locally abundant, these communities that benefit from these peaks in local abundance may be especially hard hit. Since most of the fishery associated with rural communities and small boats occurs in coastal ME, the provision to allow scallopers to temporarily relinquish their permit to fish in state waters will lessen this impact.

2. Ethnic groups

There are several ethnic groups represented in the scallop fleet. Although there is some

interaction between groups, these ethnic groups have distinct family lineages and often fish together, landing scallops at particular ports or docks. The major ethnic groups of fishermen in the scallop fishery are Norwegians, Portuguese, Italians, and Vietnamese. Although Vietnamese are generally recent entrants to the scallop fishery, no differential impact on ethnic groups or their methods of fishing is expected under Amendment #4.

3. Employment

Employment by the scallop fleet will be directly impacted by the moratorium and by effort reduction. Of the 152 vessels fishing in 1991 that will not initially qualify under the moratorium rules, 94 derived less than 15% of their 1990 fisheries income from scallops. The Council anticipates that these vessels will be able to compensate most of this loss by catching other species (Section VII.A.2).

Thirty-four non-qualifying vessels derived more than 85% of their 1991 fisheries income from scalloping. The amount of vessels that will not qualify under appeal is not known, but it is anticipated that a significant number of these boats are replacements for others that ceased scalloping. Those that do not qualify may fish for unregulated species or in other regulated fisheries that may be open to their participation. If all 34 vessels are excluded from the scallop fishery and they do not switch to other species, about 300 jobs may be lost.

Employment will also be directly impacted by the effort reduction and the nine man crew limit. Approximately 90% of qualifying scallop vessels carry less than 10 crew members (Figure 4), so significant job loss will not be caused by crew limitation. On the other hand, a significant number of scallop vessels will become uneconomic during the first few years of the effort reduction program. Catch per day fished is expected to increase immediately (Figure 32). If all 421 qualifying vessels remain in the fishery, however, the predicted declines in yield through the fourth year will lower gross stock per vessel. Since future catches are dependent on variable recruitment, the number of vessels that might survive the initial cost of the rebuilding schedule cannot be estimated.

Projected declines in yield for the first four years would tend to decrease dock-side processing. However, the overall change in dock-side processing due to other factors is inconclusive. Sutinen et al. (1992) found only 48 plants processing sea scallop in 1989. There are relatively few processors because much of the industry imports raw product. Up to 50% of scallops processed in the U.S. comes from Canada. Scallop imports from a variety of countries have increased recently (Sutinen et al. 1992). Processing employment may increase if more vessels begin to shell stock rather than shuck at sea because of the nine man crew limit.

Social impacts, or seasonal employment changes caused by the management alternatives would be directly related to future revenue (Section VII.F.3.b). Economists usually

employment with multipliers and projected monthly landings. For molluscs, direct impacts on crew are estimated at 11 man-years per $1 million; indirect impacts (e.g., suppliers), 9 man-years; induced impacts (e.g., from changes in demand), 37 man-years (Grigalunas and Ascari 1980). These multipliers may not be appropriate to the scallop fishery due to differences in infrastructure.

A combined multiplier of 57 man-years per $1 million was used to estimate the employment impacts. The non-preferred alternative (3" rings) would have the worst impact in year three with nearly 1,400 man-years lost, whereas the preferred alternative (3¼" rings) would result in a loss of 739 man-years. Both options, however, the net result would be a long-term gain of nearly 900 man-years compared to No Action. If high (F=2.25) current fishing mortality is assumed with mean recruitment, a greater economic impact is expected. The non-preferred alternative (3" rings) would have the worst impact in year three with nearly 1,700 man-years lost, whereas the preferred alternative (3¼" rings) results in a loss of 841 man-years. Both options, however, result is a long-term gain of nearly 1,500 man-years compared to No Action. These predicted changes in employment apply only to the direct employment effects.

4. Small businesses

Russell and Poopetch (1990) regarded economic arrangements, rather than technological scale, more highly. This point can best be shown by comparing family firms of the small-scale fisheries in ME with the family firms of the large-scale fisheries in New Bedford. The contrasting cultural styles are as different as the technology they deploy in the scallop fishery. But the economic organization is remarkably similar considering the added differences in their contrasting rural versus urban environments.

Relatively few ME scalloping businesses are organized as corporations, but many New Bedford family firms are. These corporations, however, limit the legal liability of the persons involved but generally do not replace the established economic infrastructure among kin. Many corporations only own one or two boats. They are run and crewed predominantly by kinsmen. These fishing operations are often considered as resources that are passed down to younger generations rather than as ventures to be sold for profit.

On the other hand, some firms are more like typical corporations. Others are "family operations" that own five boats, but even the largest corporations have important kinship relationships. Some of these firms are vertically integrated and include scallop boats, dock-side facilities, processors, wholesalers, and retailers. Large firms located in the Mid-Atlantic region frequently own up to 12 to 15 vessels and shore-side facilities.

Potential impacts of various fishery management options was an underlying concern of many fishermen and suppliers throughout the development of Amendment #4. Several options were not given further consideration because of this fear of change and economic disruption. The affect of the preferred alternative is believed to have no differential impact on small business as compared to large multi-vessel, vertically integrated firms. In fact, a key measure that allays this concern is a 5% permit ownership limit included within the permitting rules. Further evaluation of the proposed action's potential impact on small entities is provided in the Regulatory Flexibility Analysis (section IX).

5. Conclusions

Many scallop boats are reported to have a cash flow crisis, and are unable to tolerate small decreases in income. Banks may not carry them more than a short time. Fleet boats also could be hurt, but the larger corporations may be more able to absorb the financial hardships in the first few years better than individually owned vessels. No data is available, however, to determine whether the preferred or non-preferred alternatives will cause business failures in the harvesting sector.

With removal of the meat count, there may be an increased incentive for boats to switch from shell-stocking to shucking at sea. This could improve product quality, and have a

negative effect on shore-side labor. On the other hand, the nine man crew limit imposes limits on processing and catching scallops by vessels that shuck. When stock levels and catch per unit effort are high, vessels that now shuck scallops at sea may begin to shell stock to improve their efficiency in catching, rather than processing scallops.

Non-routine movements of boats will increase once the regulations are in effect. Whether effort reductions limit days at sea, or some other alternative is implemented, time on the scallop grounds will be at a premium. To the extent practical and allowed by local customs, boats might relocate to ports closer to the scallop grounds. NC boats could relocate to NJ, or perhaps New Bedford, at least on a temporary basis.

Since there is a provision to temporarily relinquish permits to the Regional Director, scallopers that fish in territorial waters under state regulations will be somewhat insulated from the effort reductions.

H. Fishery impact

The history of the scallop fishery from its inception was researched while developing the Social Impact Analysis (Appendix ?). A brief overview is given in section VI.D.4. Although Amendment #4 will substantially alter the management of the scallop fishery, it is not anticipated that it will substantially alter the historical practices of the industry. The main effects of Amendment #4 are the removal of the meat count standard and the reduction of fishing effort. The former will reverse the impact that the meat count regulations had on historical practices. Reducing fishing time will possibly lessen the need to schedule back-to-back trips which is a recent practice. It will also cause vessel operators to seek alternative fisheries if they are not otherwise restricted. This diversification is not very different from the historical practices of scallop fishermen who target other species seasonally.

The following static analysis uses the most recent year to determine potential impacts of the moratorium and the effort reduction programs. Conclusions are drawn from the revenue from other species generated by non-qualifying vessels, either as a by-catch or from directed effort. Conclusions are also drawn about qualifying vessels that will reduce fishing effort under Amendment #4.

A dynamic analysis comparing several years gives a more accurate assessment of fishery impacts. Lastly, the analysis does not explain fishing behavior. A system of behavioral equations, using both prices and costs of fishing in various fisheries, would give more realistic results.

During 1991, there were 1,849 identifiable vessels in the NMFS weighout data. Some of these vessels are well represented, especially the larger boats. Others that land scallops in

areas with inadequate sampling (primarily NC and ME), have only a few fishing trips included. Of the 1,025 vessels using otter trawls, 920 used otter trawls as their primary gear in 1991. There were also 262 vessels that used scallop dredges as their primary gear, out of 299 which had landings with scallop dredges. Similarly, there were 178 primary set gill netters, 118 primary surf clam dredges, 105 primary long liners, 91 primary offshore lobster pots, 43 primary line trawlers, and 25 primary purse seiners. The remaining 107 vessels used other gears not included in the analysis.

There are over 150 landed species recorded in the NMFS weighout system. Nearly 50 species are regularly recorded. Because certain species are caught in association with one another, it is possible to combine these species into realistic groupings that represent fisheries. Some groups are addressed by FMPs. For the purpose of this analysis, eleven fisheries defined in Table 18 are examined.

1. Dependence on Scallops

Vessels that primarily use scallop dredges produced $137 million in revenue from scallops (out of a total of $149 million by all gears), $8 million from groundfish, and $3.3 million from ADF[5] species during 1991 (Figure 12). Of the 262 vessels that were identified as using primarily scallop dredges, 207 used only dredges. For the latter vessels (Figure 13), the catch of groundfish and ADF species represents a true by-catch to scalloping. A large proportion of their landed by-catch is goosefish (Lophius americanus), commonly known as monkfish. The remaining 55 dredges use other gears and catch mostly summer flounder (fluke, Figure 14). A few vessels are also target yellowtail flounder when they are abundant. The best performers who use multiple gears fare as well as those who use only dredges.

The dependence of scallop vessels on the various fisheries and their potential for catching other species is assessed using the percentage of annual gross revenues derived for each fishery during 1991. For example, a vessel in the scallop dredge fleet may land other species such as goosefish and yellowtail flounder. Goosefish landings are often a by-catch of scallop trips while yellowtail flounder landings are often from separate, directed trips. A vessel's total gross revenue is calculated for each fishery; e.g. 73% of its revenue is from scallops, 18% of its revenue is from goosefish, and 9% of its revenue is from yellowtail flounder. This vessel would be categorized in the 70% group for scallops, the 20% group for groundfish, and the 10% group for ADF species to reflect its economic dependence on these species. The midpoints are defined in Table 19.

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[5] Atlantic demersal finfish (ADF) are ten species which are usually caught with large mesh trawls and are regulated under the Multispecies FMP. Groundfish refer to other bottom-dwelling fish excluding summer flounder. The fishery labeled "SMB" includes squids (Illex and Loligo), Atlantic mackerel, and butterfish.

Scalloping is characterized by many vessels that derive 10% of their revenue from scallops (Figure 15), and others that are highly dependent (85% to 100% of revenue from scallops). The 10% revenue group includes most of the scallop vessels that do not qualify under the moratorium. They derive most of their income from other fisheries. Nearly 95% of the total scallop revenue is generated by vessels in the 90% and 100% revenue groups.

2. Impact of the moratorium and reduced fishing effort

There were 152 vessels that landed scallops in 1991 that did not automatically qualify for the limited access fishery. These vessels will most likely redirect fishing effort to other fisheries. The impacts on vessels which remain in the scallop fishery under Amendment #4 are evaluated in Section VII.A.2. Present participation of disqualified vessels (1991) is examined vis-a-vis historical participation (1985-1990), and the relative economic dependence on scalloping versus other fisheries.

There are three caveats to this analysis. First, vessels that were in the fishery before 1985 are not considered. Prior to 1985, some States were not sampled by the weighout system. Second, some vessel owners have testified that they did not fish for scallops because their vessels were too small to catch legally sized scallops under meat count regulation. Economically, the costs to catch and land legal scallops, i.e. the costs of buying a larger vessel, were too high. Therefore, scalloping was not a practical alternative to them. The potential impact of Amendment #4 on these fishermen is negligible. Lastly, not all fishing trips for a vessel are recorded by the weighout system. This analysis points out such cases when they are known to exist. The appeal system of Amendment #4 will provide these vessel owners the opportunity to correct their landings records.

a. Disqualified vessels

Most (94) disqualified vessels are in the 10% revenue dependence group (Figure 16). There are 32 vessels in tonnage group 33 that generate a small amount of scallop revenue, a very large amount of revenue from ADF species, and minor amounts from other groundfish, surf clams, summer flounder, squid, mackerel, butterfish, hake, lobster, shrimp, herring, and other species (Figure 17).

Fishing ADF species appears to be feasible for most of these vessels if they are prohibited from scalloping. The surf clam fishery also appears to be feasible alternative for tonnage class 33 and 41 vessels. Finally, other groundfish and summer flounder appear to be the next best alternatives in most tonnage classes.

Another reason that other fisheries will be impacted is the potential lost revenue from scalloping during the effort reduction program. For the vessels in the 10% scallop

dependence group, the average vessel revenues from scallops are: otter trawls (87 vessels), $1,200 per boat ($20,000 maximum); gill nets (2 vessels) with revenues similar to the trawlers; and surf clam dredges (5 vessels) $2,000 per boat ($9,000 maximum). The provision for a the 400 pounds scallop possession limit for any vessel (providing it obtains a general scallop permit) would allow these vessels to continue to land about $1,600 worth of scallops per trip. This group of vessels is expected to continue to land scallops under the possession limit and not to redirect fishing effort to other fisheries.

Disqualified vessels from the 10% revenue dependence group primarily land scallops in New Bedford, MA (27 vessels), Hampton-Norfolk, VA (18), and Newport News, VA (15), other MA ports (14), Cape May, NJ (7), ME ports (6), MD ports (4), and Pt. Judith, RI (3). At least 12 vessels may be from NC. Since landings from NC are not recorded by NMFS, these vessels probably have other landings and revenues, including scallops, which are not contained in this analysis. Two plausible results are: 1) these vessels are more dependent on scallops than the data suggests and 2) their unrecorded scallop effort may qualify them for scallop allocations. Similar circumstances may apply to two permitees from NY and many from ME. Much of these landings and revenues are recorded in the aggregate for groups of vessels. This aggregate data will be clarified by the appeals process.

Four disqualified otter trawl vessels derived 16 to 25% of their 1991 revenues from scallops. The two smallest vessels (between 50 and 150 GRT) will probably impact the ADF fishery. The most important fishery to the other two vessels is summer flounder. Average scallop revenues for these four vessels was $12,000 with a maximum of $30,000. They primarily unload in ME (1), MA (1) and VA (2). There is one vessel with a permit address in NC (see discussion above).

All four vessels which made 26 to 35% of their 1991 revenues from scallops are small boats which use otter trawls. Their most important fisheries are SMB, hake, ADF, Other, and summer flounder, respectively. Average scallop revenues for these four vessels was $41,300 up to $95,000. Scallop by-catch from 25 to 50 otter trawl trips directed on other species may generate this revenue. These boats primarily unloaded in MA (2), RI (1) and VA (1).

Five otter trawl vessels derived 36 to 45% of their 1991 revenues from scallops. Two vessels are expected to increase their fishing effort for summer flounder (Figures 16 and 17), one vessel for groundfish, and another vessel for shrimp. The remaining vessel will probably target summer flounder, SMB, hake, or goosefish. Average scallop revenues for these five vessels was $34,500 to $110,000. Their primary ports of unloading were in ME (1), MA (1), NJ (1) and VA (2). One vessel has a permit address in NC.

Three otter trawl vessels between 100 and 150 GRT derived 46 to 55% of their 1991 revenues from scallops. The most important fishery to these vessels, other than scallops, is

summer flounder. Average scallop revenues ranged from $74,300 to $130,000. These disqualified vessels are expected to replace some or all of their scallop income by targeting summer flounder. Because the summer flounder fishery is somewhat seasonal, these three vessels may not be able to make up their lost scallop revenue. All three vessels generally unloaded in VA. However, two are from NC.

Three vessels derived 56 to 65% of their 1991 revenues from scallops, and include one trawler and two scallop dredges. All appear as if they will target the summer flounder fishery, but it will be difficult to replace their $100,000 to $200,000 scallop income from the seasonal summer flounder fishery. New Bedford (1), Cape May (1), and VA (3) are their primary ports of unloading One vessel is permitted in NC.

Similarly, five vessels which derived 66 to 75% of their 1991 revenues from scallops, include otter trawls (3) and scallop dredges (2). Again, these mid-sized (and one large) vessels are likely to target summer flounder, but it will be difficult to replace their $100,000 to $200,000 scallop income. New Bedford (1) and Cape May (2) are their primary ports of unloading. Three vessels are permitees from NC.

There are no vessels in the 76 to 85% scallop revenue group. The last two groups, 86 to 95% and 95 to 100% have similar characteristics. There are 34 disqualified vessels in these two groups. Their impacts of being prohibited from scalloping will be greater than on other disqualified vessels. Their recent participation in and experience with other fisheries is minimal. Sixteen vessels, however, have very low annual revenues. Scallop revenues range from a couple of hundred dollars to over 800,000 dollars. They have only a few recorded fishing trips recorded, implying that either 1) their scallop revenue was similar to other vessels in these two groups ($100,000 or more), 2) their scallop revenue was a small part of their total revenue, or 3) their fishing effort on scallops were under-reported and they will gain entry under the moratorium appeal process. Their primary ports of unloading were New Bedford (7), ME (8), other MA ports (6), Cape May (5), other NJ ports (2), and VA (6). Half of these vessels are permitted, two from NC, one from FL, and four from ME. Eighteen vessels have high revenues but may not be impacted as much as expected. Of 421 qualifying vessels, only 340 scallopers appear in the 1991 records. The remaining 81 had no reported 1991 landings because they sunk, were moved or sold outside of the region, or did not fish. Some may be replaced by the 34 high dependence vessels which, according to current statistics, do not qualify.

Figures 16 and 17 summarize the expected impacts on other fisheries under Amendment #4, based on 1991 weighout information. Most disqualified vessels (94) derive little income from scalloping and probably will have minimal impact on other fisheries. The 90% and 100% scallop revenue groups are the most problematic. These 34 vessels are highly dependent on scalloping. They probably have little experience in other fisheries and will need to replace over $100,000 of scallop revenue. Figure 17 shows the most likely fisheries

to be affected by Amendment #4, summer flounder, followed by ADF species. These species are expected to receive the most redirected effort caused by the scallop moratorium.

b. Effort reduction

The vessels that qualify under the moratorium will be given fewer days, on average, to fish for scallops. Some may tie-up their boats to reduce variable costs and insurance. Others will enter alternative fisheries to make their otherwise idle time more productive. The above analysis was based on a sample of 340 qualifying vessels that landed scallops during 1991.

Figure 18 shows the percent of revenue derived from each of the eleven primary fisheries compared to the percent of revenue derived from scallops. Unlike the disqualified vessels, most supplemental revenue comes from ADF species including a significant amount of yellowtail flounder, goosefish, and other groundfish stocks. Nearly 40% of current landings of goosefish come from scallop dredges. Most dredge landings of goosefish is by-catch to scallops, but directed trips are sometimes taken. Summer flounder also contribute significantly to the revenue of some vessels, primarily as a seasonal fishery. To the extent allowed under the FMPs, these vessels are likely to compensate for lost scallop revenue with ADF species, goosefish, and summer flounder, respectively.

I. Federal agencies that may be affected

The federal agencies that may be affected by proposed Amendment #4 include:

Dept. of Army Civil Works: scheduling of dredging projects, discharge of dredged materials, identification of aquatic borrow sites.

Dept. of Army regulatory 1404 Program: issuing of permits for water development projects (e.g. dredging, filling, bulkheading, construction of piers, and installation of piles).

Environmental Protection Agency: Section 401 -- individual state review of 404 discharges, Section 402 -- point source discharges, Section 404 -- discharge of dredge or fill into waters of the U.S., Section 208 -- nonpoint source pollution control. Marine Protection, Research, and Sanctuaries Act. Ocean Dumping, RCA, Superfund.

Minerals Management Service: Outer Continental Shelf Land Act, Hydrocarbon Exploration and Development, Hard Mineral Mining.

Dept. of Commerce: Endangered Species Act, Marine Mammals Protection Act,

Coastal Zone Management Act, Merchant Marine Act.

Food and Drug Administration: Federal Food, Drug, and Cosmetic Act, section 402(b)(4).

National Marine Sanctuary Program: Marine Protection, Research and Sanctuaries Act of 1972.

Dept. of Transportation, U.S. Coast Guard: Commercial Fishing Vessel Safety Act of 1988 (PL 100-424).

VIII. REGULATORY IMPACT REVIEW, EXECUTIVE ORDER 12291

This section provides the information necessary for the Secretary of Commerce to address the requirements of Executive Order 12291. The Regulatory Flexibility Analysis is in the following section. The purpose and need for management (statement of the problem) is described in §IV. The alternative management measures and enforcement costs of the proposed regulatory action are described in §V. The economic and social impact analysis of these alternatives is in this section (§VII.C&F) and is summarized below. Other elements of the Regulatory Impact Review and the Regulatory Flexibility Act are included below, and assumes that the current fishing mortality (F) is 1.63.

Determination of "Major Rule" under E.O. 12291

The proposed amendment does not constitute a major rule under Executive Order 12291 according to the following criteria. 1) It will not have an annual effect on the economy of more than $100 million. 2) It will not cause a major [long-term] increase in costs or prices for consumers, individual industries, Federal, State or local governments, or geographic regions. (Although it will cause a 14% increase in non-wage variable costs in the first year of implementation. 3) It does not have significant adverse effects (in the long-term) on competition, employment, investment, productivity, innovation or on the ability of United States-based enterprises to compete with foreign based enterprises in domestic or export markets.

Regulatory Impact Review

All of the elements required in a regulatory impact review, except the Quantitative Analysis of Benefits and Costs, are contained in the Supplemental Environmental impact statement. The parts of the SEIS that correspond to the elements of the regulatory impact review are listed below.

A. Identification and Analysis of the Problem - Purpose and Need (Section IV)

B. Management Objectives - Background (Section III.A)

C. Management Alternatives - Preferred Alternative (Section V.F.), Alternatives to the Preferred Alternative (Section V.G.) and Alternatives not being considered at this time (Section V.H.)

D. Analysis of Alternatives: The Identification of Expected Effects and the Qualitative Analysis of Benefits and Costs can be found in the following sections: Evaluation of the Preferred Alternative (Section V.G.), Alternatives to the Preferred Alternative (Section V.H.) and Alternatives

not being considered at this time (Section V.I.), Environmental Consequences (Section VII.), Social Impact Analysis (Section VII.G) and Fishery Impacts (Section VII.H) and Fishery Impact Statement (Appendix X). The Quantitative Benefit Cost Analysis is presented below.

Quantitative Analysis of Expected Benefits and Costs

The economic impact analysis (Section VII.F.) shows that the preferred option results in positive discounted cash flows over the fifteen year period compared to a continuation of the current program. They consist of a $114.1 million increase in the present value of ex-vessel net benefits (ex-vessel revenues plus cost savings and consumer surplus). All vessels will suffer a loss in years 2 through 4. However, once a higher level of landings is achieved, all vessels in the fishery will be able to operate much more productively and at much lower cost (year 5). By year 5 the scallop fleet is expected to at about the same profit level as under the no-action alternative. In year 6 and following industry profits are expected to be positive (Figure 44).

Consumers will benefit from higher sustained catches, and processors, wholesalers, distributors and retailers will enjoy increased product flow. These results are due primarily to the increases in biological productivity and reduced time at sea. The annual cost for this long-term improvement is the greatest during the third year (a $15.8 million or 24% loss in net benefits) but quickly changes by the fourth year.

Costs are measured in terms of foregone revenues (during the first few years) and the cost of equipment such as vessel tracking systems and modifications to fishing gear. Cumulative benefits accrue in the form of reduced non-wage variable costs and increased, sustainable landings and revenues after year six of implementation.

Although the total long-term (15-year) benefits are slightly greater for the Non-Preferred Alternative compared to the Preferred Alternative, the losses in the third year are unacceptably high ($25 million ex-vessel) for the Non-preferred Alternative. Both alternatives are expected to achieve the same, greater biological benefits of spawning potential, yield per recruit, and greater protection from stock collapse than No-Action.

Annual net benefits and their composition both the Preferred and the Non-Preferred Alternatives relative to No-Action are shown in Figures 39 through 42.

Near-term losses (lower landings, revenues, and consumer surplus, higher prices) are greatest in the third year for both the Preferred Alternative (effort reductions and a phased-in ring size increase) and the Non-Preferred Alternative (effort reductions with a delayed increase in ring size) compared to No Action. The expected revenues, and other impacts, for 1996 are shown in Table 43. The Non-Preferred Alternative and the Preferred Alternative are presented as differences from No Action (a continuation of the meat count

and shell height standards). Crew shares are expected to decline by $5.9 million (23.5%) during the third year under Preferred Alternative, but by $10.2 million (40.4%) under the Non-Preferred Alternative. Likewise, profits decline by $7.5 million (22.1%) under Preferred Alternative, but $11.8 million (34.8%) under Non-Preferred Alternative. Adding the changes in crew shares (-$5.9 million) and profits (-$7.5 million) from Preferred Alternative, for example, also produces the $13.4 million loss in producer surplus during the third year of implementation.

Total employment (fishermen, processing employees, lumpers, etc.) impacts are expected to mirror ex-vessel revenues. Percentage changes in total employment and total ex-vessel revenues are be identical when using employment multipliers. Models for final consumption demand (retail price) are unavailable, but assuming a simple mark-up relationship, the changes in consumer costs are expected to be about the same for both alternatives. The ex-vessel price model used in this analysis contains domestic landings, a trend variable which in part represents consumer income, as well as total import prices as explanatory variables.

Exports of sea scallops are not sizeable at present. The expected changes in change in landings for either alternative is not expected to greatly affect the import market . (see §830, Assessment and Specification of DAH, DAP, JVP, and TALFF, in the FMP). Changes in landings, prices, and revenues under the proposed management program are not expected to have different effects on vessels of different sizes. Vessels which usually land scallops in the shell (shell-stockers) generally use trawl gear, while dredge vessels normally shuck the scallops at sea and land the scallop meats. Shell-stockers receive lower prices partly because they sell an unprocessed product. Individual vessels may indeed be differentially impacted, and those impacts are described in §VII.F. The overall program is designed to affect all users equally, is not expected to hamper anyone's competitive position, and is expected to promote investment and innovation in more selective gear types. The program does, however, cap vessel parameters such as length, horsepower, and tonnage.

Compliance costs cost for vessel tracking systems, new dredges having a large ring size and for mandatory data reporting are included in the non-wage variable costs. The cost of new, larger size rings should not be an additional burden on the industry, because the phase-in period will permit suppliers to reduce inventories and fishermen to use up exiting gear under normal operation. Overall, operating and maintenance costs are expected to fall significantly. Reporting forms for the mandatory data requirements will be developed by NMFS as part of a region-wide data collection program. Administrative costs are estimated to range between $56,465 and $164,803. Estimated costs for enforcement (§V.F.4) are $1.4 million.

In summary, the Regulatory Impact Review and the Regulatory Flexibility Analysis include the expected impacts from reductions in days at sea and gear restrictions, as well as the

elimination of the meat count standard. Part of the impact of the days at sea reduction program is the elimination of vessels that do not qualify for limited access permits. Although these economic impacts are included in the overall changes in revenues, etc., the socio-economic impact on these vessels is summarized below in the Regulatory Flexibility Analysis.

IX. REGULATORY FLEXIBILITY ANALYSIS, REGULATORY FLEXIBILITY ACT

Amendment #4 is expected to have a significant impact on a substantial number of small business entities. Long-term annual gross revenues are not expected to decrease by more than 5% although net revenues are expected to decline by 25% in the third year. Long-term gross revenues are expected to increase by about 14% (Figure 37).

The Atlantic sea scallop fishing industry directly affected by this management program is composed entirely of small business entities. The vessels fish primarily in New England and Mid-Atlantic waters although some fish off of North Carolina. The Atlantic sea scallop fishery fits into the broader context of the fisheries of the Northwest Atlantic. The fleet and its dependence on scallops are described in Section VI.D. and in the Fishery Impact Statement (Appendix X). The number of scallop vessels grouped according their primary type of fishing gear is shown below.

YEAR	OTTER TRAWLERS	SCALLOP DREDGES	TOTAL
1988	167	265	432
1989	229	261	490
1990	199	284	483
1991	177	262	439

Of the 439 vessels that can be identified through the database as landing scallops in 1991, only 287 qualify for limited access permits[1]. One hundred fifty two must leave the scallop fishery or continue fishing under the 400 pound / 50 bushel possession limit, however, 94 of these 152 vessels depend on scallops for less than 15% their revenues (based on 1991 data). The other 134 qualifying vessels which did not land scallops in 1991 are expected to re-enter the fishery or be replaced. The regulatory impact analysis above provides the industry-wide impacts (assuming related processing impacts) for two alternatives. All of the vessels and processors involved in the Atlantic sea scallop fishery are considered to be small businesses according to the definition used in the Regulatory Flexibility Act. The annual costs of compliance for the third (worst) year are shown above, and the overall net benefits in terms of discounted cash flows are presented in §VII.F., for the industry. Given the potential for 421 qualifying vessels operating in 1996, the average impact (worst case) in

[1] There are recorded landings in the 1991 weighout files for 340 of the 421 qualifiers, but 53 of these vessels did not catch any scallops. This illustrates the flexibility of vessels which do not depend heavily on scallops, particularly those that use trawl gear.

terms of foregone revenue with the preferred option is $33,000 per vessel out of average gross revenues of $231,000 per vessel in the first year. Annualized compliance costs are estimated to be about 1% of gross revenues for VTS in 1994 ($3,135 per boat). Equipment costs are expected at 0.6% of gross revenues for 3¼" rings in 1994 and 0.8%, for 3½" rings in 1996.

Vessel class scallop dependence is described in §VI.D.1.e. of the SEIS and in more detail in the Fishery Impact Statement (Appendix X), which show that smaller vessels tend to depend less on scallop revenues than do the larger vessels. The dependence of different port areas on different resource areas is described in §§VI.D.1.d&f of the SEIS. The Council has relied on its scallop industry advisory Committee and information received through the public hearing process to assure that any groups within the industry, such as those who use a particular type of gear or have a certain size of vessel are not unduly hurt by the proposed action. During this process, the Council uses public comment to adjust the management program so that differential impacts are avoided to the greatest possible extent. Finally, the impact on the 152 disqualified vessels under the limited access program is evaluated in §VII.A.2.a., and indicates that these vessels are expected to increase their participation in the summer flounder and multispecies fisheries.

X. COASTAL ZONE MANAGEMENT ACT

The Council has submitted Amendment #4 to the Atlantic Sea Scallop FMP to the Coastal Zone Management Programs of coastal states from Virginia to Maine, inclusive, for review. Copies of the transmittal letters that have the Council's determination of whether the proposed measures are consistent with the coastal zone management plans for the individual states are contained in Appendix XI. The Council provides an evaluation of how the proposed action might impact the coastal zone in section VII.B.

XI. ENDANGERED SPECIES ACT

There is no evidence that any of the proposed alternatives will have a significant detrimental effect on endangered or threatened species. An evaluation of the threat to species afforded protection under the Endangered Species Act is found in section V.G.7. There is little documented evidence of interactions between protected species and fishing for sea scallops. Since this fishing activity is confined to cooler offshore waters (especially in the southern portion of the sea scallop range), mortality on sea turtles is believed to be minimal. To insure that threatened and endangered species are not placed in peril from scalloping under the FMP, the Council has included specific measures for monitoring within § 860.

As a result of the consultation required by Section 7 of the Endangered Species Act, NMFS has concurred that the fishing operations conducted under the amended FMP are not likely to adversely impact endangered or threatened species under the jurisdiction of NMFS (Appendix IX).

XII. MARINE MAMMAL PROTECTION ACT

The Council cannot cite evidence that scalloping endangers any species of marine mammal. An evaluation of marine mammals found within the managment unit and the possibility of their interaction with scalloping is contained in section V.G.7.

XIII. AMENDATORY LANGUAGE

The following amendments provide specific language to revise or replace existing sections in parts 8 and 9 of the Atlantic Sea Scallop FMP. Because of the integration of the SEIS into Amendment #4, parts 1 through 7 of the FMP should be updated with the information presented within the SEIS. Specifically, part 1 (Introduction) is amended to include the information contained within sections III (Summary) and IV (Purpose and Need). The specification of the management unit (§ 130) remains unchanged.

Part 2 (The Sea Scallop Resource) is amended to include the updated information in sections VI.B (Sea Scallop Life History) and VI.C (Habitat and Physical Environment). Part 3 (The Sea Scallop Fishery) is amended to include the updated information in section VI.D (Description of the Fishery). Part 4 (Management Jurisdictions, Laws and Policies) is amended to include the updated information in section VII.E (Cumulative Adverse Impacts with Other Laws, Regulations, and Plans). Part 5 (Management Objectives) remains unchanged. Part 6 (Alternative Management Strategies) is replaced by section V (Preferred Alternative) which describes the proposed action and other non-preferred actions.

Part 7 (Detailed Analysis of Alternative Strategy Specifications) is replaced by the information in section VII (Environmental Consequences). Specifically, § 710 is replaced by the revised biological analyses and projections in sections VII.A (Impacts on Stocks) and VI.F.2 (Landings Forecasts). § 720 (Economic Analysis) is replaced section VII.F.3 (Cost-Benefit Analysis). § 730 (Conclusions) is replaced by sections III.C (Major Conclusions), VII.F.3.i (Summary), VII.G.5 (Conclusions), and VII.H (Fishery Impact).

§ 810. Preferred Alternative and Optimum Yield

Amendments to replace existing language:

Preferred Alternative

The Council selects an overall management strategy that combines implementation of measures which control fishing mortality through limited access effort control, with supplementary measures to control age-at-entry. This management strategy eliminates the meat count standard because it has not prevented over-exploitation of the sea scallop resource, as well as caused problems of acceptance by fishermen and enforceability. Fishing effort will be reduced from current levels over seven years until current fishing mortality falls below the overfishing definition.

The original FMP (January 1982, pp. 78-79) indicated that "the immediate imposition of an effort control measure is not essential to assure long-term benefits from control on age-at-first-capture, so long as some form of fishing mortality control is adopted or fishing mortality does not substantially increase". The FMP cited several important shortcomings to successful implementation of effort control measures, including: the need for simultaneous control on gear/vessel efficiency and size(age)-at-first-capture; the lack of

data availability for all fishery components; and most importantly, very little basis for accurately assessing the actual fishing mortality being generated by the scallop fleet. Since that time fishing mortality has been adequately assessed, fishery data collection has expanded from Maine to Virginia, and the measures herein now control fishing mortality through fishing effort, age-at-entry and gear/vessel efficiency (supplementary measures). These measures will achieve a fishing mortality goal within seven years to a level consistent with the overfishing definition.

The management unit to which the above measures shall apply includes those sea scallop populations described in § 130 and encompasses all commercial and recreational fishing activity affecting those populations. That is, the management unit includes sea scallops in the territorial waters of the States throughout the range of the sea scallop as well as those found in offshore areas.

Definition of Overfishing

According to Guidelines for Fishery Management Plans (50 CFR part 602), "overfishing" shall be defined for all stocks managed under the Magnuson Fishery Conservation and Management Act (MFCMA). The federal guidelines require that if a stock is overfished, the fishery management plan for that stock should include a rebuilding schedule. The overfishing threshold may be defined in terms of recruitment overfishing. In other words, a stock that is unable, because of fishing levels, to produce enough new recruits to sustain itself at average levels over the long-term is overfished. Other definitions of overfishing that restrict levels of fishing to a greater degree may also be used.

Overfishing for Atlantic sea scallops is defined as a fishing mortality rate that, if continued, results in a spawning stock biomass of five percent of the maximum spawning potential. The corresponding target fishing mortality (F) will be calculated as a level that will result in a 5% MSP under equilibrium conditions.

The fishing mortality rate that estimates the current level of fishing on all Atlantic sea scallop stocks is defined as the average mortality on fully recruited age classes weighted by the relative number of scallops within each stock. When age-structured assessments are not available for individual stocks, current fishing mortality estimates from other sources, such as changes in fishing effort or survey based data, will be used.

The MSP threshold may be adjusted as additional biological evidence becomes available. To make changes to the MSP level, the updated targets will be reviewed by the Scallop Plan Development Team and approved by the Scallop Committee and Council under Abbreviated Rulemaking.

This definition in terms of percent maximum spawning potential as the biological reference

point, 5% MSP as the threshold, and anticipated changes in the overfishing definition are explained in SEIS Appendix V, Overfishing Definition for Atlantic Sea Scallops. For the Georges Bank/Mid-Atlantic stocks of Atlantic sea scallops, the proposed overfishing threshold could allow up to 60% (F_{rep} = 0.97) of scallops larger than 70mm shell size to be harvested every year. A level of 5% MSP falls within a range which is associated with several biological reference points, such as the SSB/R ratio that passes through the recruitment maximum and for several different time periods. The 5% MSP level is considered to be a base level, from which the Council then may strive to achieve other objectives. Preliminary analysis indicates that fishing mortality rates have been above the threshold level for the last decade. For comparison purposes, F_{max} equals 0.22 in Delmarva and 0.23 in the South Channel resource area.

Optimum Yield

Because of the decision not to adopt control on quantity landed as a strategy in the Atlantic sea scallop management program, the actual catch in the sea scallop fishery will be a consequence of the structure and economics of the industry in relation to the abundance/age-structure of the resource.

Optimum Yield in the Atlantic Sea Scallop FMP is therefore defined as that amount of annual, domestic sea scallop catch that results from implementation of the sea scallop fishery management program. The provisions of the management program are designed to: (1) generate increased long-term benefits from the harvesting and use of the sea scallop resources, and (2) provide the Council with necessary information for future improvements and modifications to the management program as deemed appropriate.

§ 820. Conservation and Management Measures

Amendments to replace existing sections:

§ 821. Fishing Effort Control

Fishing mortality will be controlled by limiting the total number of days that can be spent at sea fishing for scallops, thus controlling the number of vessels and the number of days that they may spend at sea. These days at sea will generally be allocated to three groups based on vessels' directed fishing effort during 1985-1990. Fishing effort will be reduced from current levels (F=1.63) over seven years until fishing mortality falls below $F_{5\%}$ (F=0.97), the overfishing threshold. During two years (pause years), there will be no effort reductions and the Council will evaluate the linkage between total days at sea and fishing mortality. Adjustments to the effort reductions will be made as appropriate. In summary, fishing mortality is being controlled by total days at sea, which is the product of both the number of vessels and days per vessel.

Days-at-sea Control

Table 45 shows the days-at-sea schedules with 3¼ inch rings required during the first two years, and 3½ inch rings required thereafter. Days-at-sea will be recorded as cumulative hours. Total days at sea in the Atlantic sea scallop fishery will be reduced by 11.0% in year two and by 11.1% in years 4, 5, and 7, with two pauses in years 3 and 6, to reduce current (1990) F of 1.63 to the target F of 0.97. Total days at sea were reported at about 48 thousand days in 1990 - the latest fishing mortality assessment and thus starting point for effort reduction. Landings will depend on the level of recruitment (the age-class of small scallops just starting to be caught commercially) during a particular year, but are not expected to fall to less than 80% of what they would be under No Action and should achieve levels over 110% greater at equilibrium.

Annual, days-at-sea limits for all scallop vessels (both dredges and other gears) under limited access will be allocated into 3 groups; full-time, part-time, and occasional participants. The assignment of vessels to each group is based on historical performance of the vessel. All vessels within a group will be allowed the same number of days. The rationale for this particular form of allocation is that all participants will be treated equally, at least within groups, and reliance on the voluntary, weighout database will be minimized. However, one DAS limit across the entire fleet will result in pulling full-time operators down to part-time status and allowing truly occasional/by-catch operators to move up to part-time status.

Directed fishing for Atlantic sea scallops is defined as days at sea on fishing trips when at least 400 pounds of shucked (or 50 U.S. bushels of shellstock) Atlantic sea scallops are landed. There are several methods for determining a vessel's directed scallop days:

(A) Basic Six Year History Formula - historical performance is based automatically on the qualified vessel's days at sea during 1985-1990, as recorded in the NMFS weighout files, as follows:

4+ years activity =	exclude high and low years, average remaining years;
3 years activity =	average high and low years, average again with third year;
2 years activity =	average of two years;
1 year activity =	use one year.

(B) Current Owner's History Formula - if a vessel's status as a full-time/part-time/occasional participant is under appeal and that status has changed over the relevant time period, 1985-1990, then the vessel's performance under the current owner be used with the formula in (A) above.

(C) 1990 History - considering present participation and dependence on the fishery, no vessel should be disadvantaged by its longevity in the fishery relative to more recent entrants and any vessel may use only its 1990 days at sea to determine its status (full-time, part-time or occasional) in the limited access fishery.

(D) Entry Year History Formula - a vessel's entry year into the fishery shall be pro-rated to a full-year, based on evidence from the owner showing the date of start-up, and then applied to the formula in (A) above.

The vessel is then placed into a three group system that divides the fleet into full-time, part-time, and occasional categories:

Full-time fleet: Vessels must have averaged at least 150 days at sea (any 24 hour period or fraction thereof) annually, directed for Atlantic sea scallops.

Part-time fleet: Vessels must have averaged more than 37 but less than 150 days at sea (any 24 hour period or fraction thereof) annually, directed for Atlantic sea scallops.

Occasional fleet: Vessels must have averaged 37 days at sea or less (any 24 hour period or fraction thereof) annually, directed for Atlantic sea scallops.

Small Gear Exception - limited access vessels are allowed to step up one days-at-sea category (for example, from part-time to full-time) if 1) they declare [under the annual declaration program] in advance that they are going to fish for scallops exclusively throughout the year with a maximum size 10.5 foot dredge, 2) they carry only one dredge aboard, and 3) they carry no more than five crew [including the captain].

Appeal of days at sea group assignment must be in writing during the initial year of the effort control program, and will include any of the following grounds:

(i) The allocation was based on mistaken or incorrect information or data;
(ii) The applicant was prevented by circumstances beyond his/her control from meeting relevant criteria; or,
(iii) The applicant has new or additional information which might change the initial decision.

Evidence that may be used as proof during the appeals process includes but is not limited to state landings data, packout forms, settlement sheets and/or other corroborative proof such as cancelled checks and signed affidavits from dealers. All evidence for appeals shall be acceptable at the discretion of the Regional Director and the appeal board. The applicant

will have a right to an oral hearing.

Vessels appealing for a higher days-at-sea group may only scallop at the next highest level [from the one in which they have been initially classified] regardless of the group into which they are appealing, unless they show evidence of participating in at least 10 trips (landing more than 400 pounds or 50 U.S. bushels) in 1991 or 1992 or any consecutive 12 months within that period, which would allow them to fish for scallops at a full-time level pending the outcome of their appeals; vessels must show at least 5 trips, to scallop at a part-time level pending appeals.

Limited Access to Vessels (Permanent Moratorium)

The number of vessels allowed to direct fishing for Atlantic sea scallops will be limited until the effort control program is amended. Directed fishing is landing more than 400 pounds of shucked (50 U.S. bushels of shellstock), Atlantic sea scallops on a fishing trip, as above. This limit on participation is intended to accomplish two objectives. First, it will be needed to control fishing effort. Without a limit on the number of participants, there would be no way to effectively allocate future days at sea. An effort reduction target of ten percent of days at sea for individual vessels, for example, could be negated by a ten percent increase in the number of vessels - therefore, no net reduction in fishing effort would be achieved.

Further, to allow all vessels with a history in the scallop fishery to participate would require management measures which would make scallop fishing uneconomic for most full-time scallop dredge vessels. For instance, by allowing all vessels which meet the 400 pound (50 U.S. bushels) per trip criterion to qualify, the effort reduction program would begin with 570 vessels. By following the limited access rules defined below for the Atlantic sea scallop fishery, that number is reduced to 403 - 421 vessels [depending on appeals] with a stake in the fishery. Five hundred and seventy vessels in the fishery, given that most were low-end operators, would require much lower mean days at sea per vessel under the effort reduction schedules.

The second objective addresses the concern of many fishermen who are being forced to radically change their traditional fishing behavior under the effort reduction program. These fishermen must take short-term reductions in catch through the reduced effort allocation, and argue that they should be the ones to benefit from the rebuilding program. Without a limit on access to the fishery, vessels that have not been forced to make the sacrifices under the effort reduction program could enter the fishery as soon as stocks begin to rebuild. Additional entry would dissipate the economic benefits and reduce incentive to abide by the rules of the effort reduction program.

Limited Access Rule: Allocation of days at sea for Atlantic sea scallops will be restricted to

those vessels with federal or state scallop permits and scallop landings in excess of 400 pounds (50 U.S. bushels) of scallop meats on any trip recorded in either the 1988 or 1989 weigh-out data files (new vessels have up to March 1990 to establish their 400 pound/50 U.S. bushels scallop trips) or in state weigh-out files. Other evidence that could be used as proof during the appeals process includes but is not limited to packout forms, settlement sheets and/or other corroborative proof such as cancelled checks and signed affidavits. All evidence for appeals shall be acceptable at the discretion of the Regional Director and the appeal board, and they will use such evidence and information as will lead to a fair and responsible decision on appeals.

Limited access permits will be required on all vessels that have more than 400 pounds of scallop meats or 50 U.S. bushels of shellstock onboard, or which land more than those amounts within one calendar day.

Vessels not qualifying for limited-access permits may apply for a general category scallop permit and will be restricted to possessing onboard no more than 400 pounds of scallop meats, or 50 U.S. bushels of shellstock. These vessels may not land more than these limits within one calendar day.

New or Re-rigged Vessels: New or re-rigged vessels may qualify in two ways:

(A) Vessels may obtain a limited access permit if they meet the following criteria: a) new vessels must have been under construction or re-rigging for directed scallop fishing by the March 2, 1989 cutoff date or they must have possessed a written construction contract prior to that date; and b) they must have landed any scallops and possessed a permit by March 2, 1990; or

(B) Vessels may also qualify for a limited access scallop permit if they meet the following criteria:

1) The vessel changed ownership between March 2, 1989 and November 28, 1990 [the date the participation in 1988-1989 requirement was published];

2) The vessel had a scallop permit and landed scallops at some time during 1982 to 1988;

3) The vessel landed at least one trip of 400 pounds of scallop meats (50 U.S. bushels of shellstock) or more during 1990.

The days at sea category for vessels qualifying under (B) shall be determined under the classification system used for the fleet as a whole provided however, that such vessels shall not qualify for a category higher than that for which they

would qualify using the average of their 1991 and 1992 days-at-sea history.

Vessel Replacement or Upgrading: Vessels with days at sea allocations may be replaced under the same limited access permit, but must be restricted to the same total effective fishing power and must remain within the same or a lower fleet category. Vessels cannot be upgraded in terms of total effective fishing power or fleet category, but may move down in category. The limitations on replacement vessels or upgrading of vessels are that length, gross registered tonnage, or net tonnage may not be increased by more than 10 percent, and horsepower by more than 20 percent of the combined horsepower of all engines, in any refit or replacement. This restriction on upgrading will go into effect upon implementation of the regulation, and each vessel will be limited to one upgrade.

Annual Declaration: To receive a limited access permit, owners must annually declare their intent to have their vessel participate in either the full-time fleet, part-time fleet, or occasional fleet by completing a permit application form. The application period for the following year extends from October 1 to December 31 of the preceding year. Owners who fail to declare their intention for any year may not have their vessel re-enter the scallop fishery to receive days at sea allocations.

Tendering a permit: Owners wishing to fish with their vessels in state waters under state regulations may relinquish their limited access permit to the Regional Director. That permit may be held by the Regional Director for the applicant's future use if he expresses his intention to re-enter the scallop fishery in the EEZ at a later date.

Appeal of Permit Denial: During the initial year of the effort control program, any applicant denied a limited access permit may appeal the denial. The appeal must be in writing, and any of the following grounds may be a basis for review:

(i) The denial was based on mistaken or incorrect information or data;

(ii) The applicant was prevented by circumstances beyond his/her control from meeting relevant criteria; or,

(iii) The applicant has new or additional information which might change the initial decision.

Any evidence will be considered and may be deemed acceptable by the Regional Director and the appeals board, and they will use such evidence and information as will lead to a fair and responsible decision on appeals. The applicant will have a right to an oral hearing.

Vessels appealing a denial of a permit under the limited access program must show evidence of participating in at least 10 trips (landing more than 400 pounds or 50 U.S.

bushels) in 1991 or 1992 or any consecutive 12 months within that period, to be allowed to fish for scallops at a full-time level pending the outcome of their appeals. Vessels must show at least 5 trips as defined above, to scallop at a part-time level pending appeals.

Supplementary Measures

Crew size: All limited access vessels (dredge, trawl, and other) will be restricted to a maximum crew of nine while fishing for scallops. Qualifying vessels that are permitted under the 10.5 feet dredge exception will be restricted to a maximum crew size of five. This limitation includes the captain and all personnel aboard the vessel while fishing, except persons authorized by the Regional Director. Limited access vessels do not have restrictions on crew size while fishing for other species and possessing less than 400 pounds (50 U.S. bushels) of scallops. This measure is intended to help limit efficiency improvements which would tend to mitigate fishing effort reductions.

Shucking and sorting machines: Shucking machines are prohibited on board vessels possessing or landing more than 400 pounds (50 U.S. bushels) of scallops, as are sorting machines for vessels which shuck more than 400 pounds of scallops at sea. These measures are intended to help to restrict improvements in technology which would tend to mitigate fishing effort reductions.

3½ inch minimum shell height: The minimum shell size is specified at 3-1/2 inches and is applicable to sea scallops in the shell that are either caught recreationally or harvested by the shell-stocking sector of the fishery. The minimum shell size is subject to a tolerance of 10% by number less than the specified value. The minimum size measure will prevent wholesale movement into this type of fishery in order to circumvent the management measures designed around the scallop dredge/shucking operation.

400 pound, 50 U.S. bushels, trip limit for non-qualifying vessels: General permit vessels may fish for scallops or possess and land them as a by-catch if the weight meats does not exceed 400 pounds or the amount of shellstock does not exceed 50 U.S. bushels (2150.42 in^3). No more than these amounts may be landed by a scallop vessel within one calendar day.

Dredge restrictions: The escapement of small scallops and by-catch will be enhanced through the following provisions:

> All scallop dredges will be required to use at least 3¼" rings upon the date of implementation. At the beginning of year three of the fishing effort reduction schedule, all scallop dredges will be required to use at least 3½" rings. Vessels may not possess rings onboard which are less than these limits.

A maximum 30-feet total dredge width (for example, two 15 feet dredges) will be required onboard. Qualifying vessels may apply for an alternative permit that requires a single ten foot, six inch (10.5 feet) dredge and the applicant will receive a one-category increase in days at sea. This restriction will remain in place until the annual permit expires.

Chafing gear, cookies, or any devices which obstruct the top *half* of the dredge gear are prohibited on any scallop dredge. Scallop dredges are required to have no more than double linking between rings.

Additionally, a minimum mesh of 5½" for twine-tops will be required on all dredge gear.

Trawl Restrictions: The escapement of small scallops and by-catch will be enhanced through the following provisions:

All trawl vessels which trawl north and east of Hudson Canyon and possess or land more than 400 pounds, 50 U.S. bushels, of scallops will be limited to at least 5½" minimum mesh (throughout the top and bottom), and no chafing gear will be permitted in the top half of the net. Scallopers using trawls south and west of Hudson Canyon are required to use mesh no less than 5". All scallop trawlers will be limited to a 5½" minimum mesh after year two. The Regional Director will establish a line running through Hudson canyon for this purpose and will consider the recommendations of the industry, the U.S. Coast Guard, and the Council.

All trawl vessels which possess or land more than 400 pounds, 50 U.S. bushels, of scallops are limited trawls with a maximum 144-feet sweep.

Experimental fishing exemption:
Upon the recommendation of the Council, the Regional Director may exempt any person or vessel from the requirements of this part for the conduct of experimental fishing beneficial to the management of the sea scallop resource or fishery. The Regional Director may not grant such exemption unless it is determined that the purpose, design, and administration of the exemption is consistent with the objectives of the FMP, the provisions of the Magnuson Act, and other applicable law, and that granting the exemption will not:

(1) Have a detrimental effect on the sea scallop resource and fishery; or

(2) Create significant enforcement problems.

Each vessel participating in any exempted experimental fishing activity is subject to all provisions of this part except those necessarily relating to the purpose and nature of the exemption. The exemption will be specified in a letter issued by the Regional Director to each vessel participating in the exempted activity. This letter must be carried aboard the vessel seeking the benefit of such exemption.

§ 822. Compliance Monitoring and Enforcement

Days at Sea Monitoring via Transponders: Limited access vessels will be tracked through a monitoring program for the days-at-sea measure. The use of vessel transponders (VTS), or other systems authorized by the Regional Director, will be mandatory for full-time and part-time vessels. For vessels in the occasional group, and all vessels during the interim period before transponders can be installed, participation in a call-in program will be required. Vessel tracking systems must be operational at all times, 365 days per year, for full-time and part-time vessels. Days at sea will be recorded as cumulative hours.

At the discretion of the Regional Director, vessel owners may petition to have days-at-sea recorded by VTS not counted if: (1) the VTS breaks down and the vessel is not scalloping; (2) a scalloping trip ends with no catch [broker trips, which did not count as days at sea for qualification and group assignment under this amendment]; or (3) the vessel spent time assisting another vessel in distress. The Regional Director may require corroborative proof such as Coast Guard reports, etc.

400 Pound Exemption Monitoring: For vessels with general permits, possession of more than 400 pounds of shucked, or 50 U.S. bushels of shellstock, Atlantic sea scallops will be prohibited. Enforcement of this measure will occur dockside and at sea. Scallop landings by vessels with general permits, however, must be reported (§ 850).

Annual Declaration: To receive a limited access permit, owners must annually declare their intent to have their vessel participate in either the full-time fleet, part-time fleet, or occasional fleet by completing a permit application form. The application period extends from October 1 to December 31 of the year preceding the fishing year. Owners who fail to declare their intention for any year may not have their vessel re-enter the scallop fishery to receive days at sea allocations.

Operator's Permits: Operators of sea scallop vessels with either limited-access or general permits must have operator permits to participate in the scallop fishery. No performance or competency tests will be required to obtain a permit, however, the permit may be revoked for violation of scallop management regulations. To address the plan objective of evaluating (minimizing) the impact on enforcement costs and assure effectiveness, the Council proposes to require that vessel operators be permitted.

Percentage Ownership of Limited Access Permits: Limited access permit holders must provide the correct name, address, and telephone number of the principal owner, and report any change in principal owner within 15 days. This information will be used to establish compliance with the 5% ownership rule.

Fishing Power Monitoring through Permit Applications: Vessels permit holders must report any change in the information on the permit made since August 3, 1992 within 15 days of the date of implementation, and within 15 days of any change thereafter.

Crew Size: The crew size limits will apply to all limited access vessels when they possess more than 400 pounds or 50 U.S. bushels of Atlantic sea scallops.

Shucking and Sorting Machines: Shucking machines will be prohibited on all vessels with limited access permits which possess or land more than 400 pounds or 50 U.S. bushels of scallops. Sorting machines will be prohibited on all vessels with limited access permits which possess or land more than 400 pounds or 50 U.S. bushels of scallops, and which shuck Atlantic sea scallops at sea.

3½ inch Minimum Shell Height: The minimum shell height standard applies to the direct and indirect harvesting of sea scallops from all areas under United States jurisdiction and by every sector of the commercial and recreational fisheries. The minimum shell height standard will be sampled and monitored for compliance as developed by the NMFS Enforcement Division, and shall occur primarily at the dock and at the end of a vessel's trip. The Council recognizes, however, that at-sea enforcement may be necessary under certain circumstances when, for example, regulatory measures applicable to territorial waters are not yet complementary to federal regulations and at-sea enforcement is necessary. Enforcement of the minimum shell height standard shall be accomplished through a prohibition against the possession of non-conforming sea scallops up to and including the point of first transaction in the United States. The Council's intent in adopting the possession measure is to distribute the responsibility for compliance with the measures among all who participate in those first-point-of-sale commercial sea scallop transactions, as well as those involved in the actual harvesting, and to thereby expand the time frame in which enforcement can be accomplished.

Gear Composition Monitoring at sea/on dock: Scallop dredge gear, and trawl gear on any vessel with a limited access permit, may be checked for compliance at any time. Vessels with a general permit and possessing or landing scallops may be checked for compliance.

Transfer of Atlantic sea scallops from one vessel to another at sea will be prohibited.

§ 823. Licensing and Permits

General Permits: Any vessel taking and landing sea scallops must obtain a general scallop permit from the Regional Director of the National Marine Fisheries Service. Any U.S. vessel is eligible for a sea scallop permit, but it cannot be transferred to another vessel. The primary purposes of the permit are to enforce the management measures (minimum shell height standard, maximum 400 pound/50 U.S. bushels possession, scallop dredge restrictions, transfer at sea prohibition, and mandatory data reporting), to collect fishery statistics (§ 850) and to identify participants. Information obtained is necessary to provide a continuous review of conditions in the fishery and to meet the Council's objectives for continuing management (see section 840). For example, data acquired under these measures will allow the Council to analyze the various approaches to achieve control on fishing mortality and develop appropriate adjustments as required (see section 842). Vessel permit holders must report any change in the information on the permit made since August 3, 1992 within 15 days of the date of implementation, and within 15 days of any change thereafter.

Limited Access Permits and Permit Ownership: Limited access permits will be issued for qualifying vessels described by the specifications found on the scallop permit as of August 3, 1992. Permits may be transferred with the sale of the vessel or to a replacement vessel, but owners may not increase a vessel's fishing power as defined above. Additionally, the vessel must remain in the same fleet category or move to a lower category (in the Atlantic sea scallop fishery), but may not move to a higher category. No entity or individual may have ownership interest in more than five percent of the total number of vessels with limited access permits in the Atlantic sea scallop fishery, except as a result of a reduction in the initial number (including the eventual results of appeals) of vessels. Changes to the information required on permits must be reported within 15 days.

Operator's Permits: The primary benefit of an operator's permit is to provide for accountability. Upon application for the permit, permit holders would be notified that if they violate the regulations they may receive a permit sanction, which forfeits their right to work in any capacity on any commercial vessel fishing for federally regulated species during the period of sanction.

Program Requirements:

a) Any operator of a vessel fishing for Atlantic sea scallops must have an operator's permit issued by the NMFS Regional Director.

b) An operator would be defined as the master or other individual on board a vessel who is in charge of that vessel. (Note: this definition is specified in the Code of Federal Regulations, CFR 50 part 620.2.)

c) The operator would be required to submit an application, supplied by the Regional Director, for an Operator's Permit. The permit would be issued for a period of up to three years.

d) The applicant will provide his/her name, mailing address, telephone number, date of birth and physical characteristics (height, weight, hair and eye color, etc.) on the application, and would be requested to provide his/her social security number. In addition to this information, the applicant would provide two passport-size color photos. Any changes to the information required on permits must be reported within 15 days to the NMFS Regional Director.

e) The permit will not be transferable.

f) Permit holders will be required to carry their permit aboard the fishing vessel during fishing and off-loading operations and must have it be available for inspection upon request by an authorized officer.

h) The Regional Director may, after publication in the Federal Register, charge a permit fee for administration and enforcement.

Dealers' Permits

The primary purpose of a dealer permit is to improve enforcement of the regulations through dealer accountability. A second purpose is to improve the administration of the FMP by identifying the participants in the fishery and their principle business locations. Once identified, the Council and NMFS can provide notices and other information to dealers on changing regulations that might have an impact on how they conduct their business. Regulations that dealers may be concerned with include recording time landed (for days at sea) and amount of landings, minimum shell sizes, trip limits or possession limits (by-catch), or potential landing windows that might interrupt the supply of product in the short term. Identifying dealers also provides a secondary avenue for information dissemination to fishing vessels.

Program Requirements:

a. Any dealer of sea scallops must have a permit issued by the Regional Director.

b. A dealer will be defined as the person who first receives fish by way of

purchase, barter, or trade. (Note: this definition is specified in CFR 50 part 620.2.)

c. The dealer would be required to submit an application, supplied by the Regional Director, for a Processor/Dealer Permit which would be issued for the period from January 1 to December 31 of each year.

d. The applicant would provide the name of the person signing the permit, name of the business, mailing address, telephone number and principal place of business on the application. Any changes to the information required on permits must be reported within 15 days to the NMFS Regional Director.

e. The permit would not be transferable and would expire upon change in ownership of the business.

f. The permit must be maintained at the place of business and be authorized for inspection upon request by an authorized officer.

g. The Regional Director may, after publication in the Federal Register, charge a permit fee for administration and enforcement.

§ 840. Continuing Fishery Management

Amendments to replace existing sections:

§ 842. Regulatory Adjustments in Management Measures

As in the Pacific Coast Groundfish FMP, three types of frameworks will be used to classify proposed changes to the management measures. Each framework provides guidance on the necessary amount of public review and comment and, therefore, dictates the procedure that the Council will follow in making the recommendations. If the NMFS Regional Director does not concur with any part of the Council's recommendations, the Council will be notified in writing of the reasons for rejection. The Secretary is expected to waive for good cause proposed rules and comments by publishing a final rule in the *Federal Register*. These guidelines are not intended to derogate from the Secretary's authority to take emergency action under section 305(e) of the Magnuson Act.

Three frameworks are defined in 50 CFR 663 to be used under various conditions which are explained in section V.F.3 of the SEIS. The first framework establishes a procedure for classifying and adjusting "routine" management measures. The "points of concern" framework allows the Council to develop management measures that respond to resource conservation issues. The "socio-economic" framework allows the Council to develop management measures in response to social, economic, and ecological issues that affect the fishing community. Associated with each framework is a set of criteria that form the basis for Council recommendations and with which Council recommendations will be consistent.

The framework procedures in 50 CFR 663 establishes a general process for developing and implementing management measures that normally will occur over the span of at least two Council meetings, with an exception that provides for more timely Council consideration under certain specific conditions. These conditions are explained in more detail in 50 CFR 663, App.III.B. As in the Pacific Groundfish FMP, Amendment #4 contemplates that the Secretary will publish management measures recommended by the Council in the *Federal Register* as either "notices" or "regulations." Generally, management measures of broad applicability and permanent effectiveness are intended to be published as "regulations." Those measures that are more narrow in their applicability and which are meant to be temporary or require frequent adjustment are intended to be published as "notices." At this time, the Council intends the management measures listed below to be implemented by the former process (i.e. "regulations") rather than the latter.

General procedures and criteria

Adjustments to the management measures contained in Amendment #4 are anticipated at specific intervals within the seven year rebuilding schedule (section V.C.3). This intention

does not preclude making adjustments at other appropriate intervals. The proposed days at sea schedule for full-time, part-time, and occasional vessels is, however, intended to remain in place for three years until the fishing mortality and effort relationship, and the impacts of the new gear restrictions can be more fully understood. Four procedures for adjusting management measures are available under 50 CFR 663, 1) automatic actions, 2) "notice" actions, 3) abbreviated rulemaking, and 4) full rulemaking through regulatory amendment. Each action has specific criteria and requires different amounts of opportunity for comment. Satisfaction of the legal requirements of other applicable law (e.g. the Administrative Procedure Act, Regulatory Flexibility Act, Executive Order 12291) for actions taken under this framework requires analysis and public comment before measures can be implemented by the Secretary.

All management measures proposed or considered by Amendment #4 may be established, adjusted, or removed using any of the four procedures. Even though certain measures are proposed to be developed within a specific framework process, the Council may through majority vote require development through a more stringent process should public testimony or conditions warrant. Although some adjustments will have impacts that fall within those analyzed during the development of Amendment #4, e.g. adjustments to days at sea, the Council proposes to classify all adjustments under the abbreviated or full rulemaking processes because of their controversial nature or because of the potential for differential impacts. Other potential actions that may be taken via abbreviated and full rulemaking cover a wide range of potential impacts, analyses of biological, social, and economic impacts will be performed and evaluated when a particular change is proposed. During future adjustments, however, the Council may consider further adjustments to a measure to be routine and non-controversial and may reduce their framework requirements and process to "Notice" actions or automatic adjustments. The four basic categories of management actions are as follows:

a. Automatic actions

Actions proposed under this procedure may be initiated by the Regional Director without prior public notice, opportunity to comment, or through a Council meeting. These actions are non-discretionary and the impacts must have been previously analyzed and taken into account. The Secretary will publish a single "notice" to make the action effective.

b. "Notice" actions

These actions are intended to have temporary effects and are expected to need frequent adjustment. They may be recommended at a single Council meeting, although it is preferable that the Council provide as much advance information to the public as possible. Management actions in this category are either non-discretionary or the scope of probable impacts must have been previously analyzed and taken into account. At least one Council

meeting is required and the Secretary will publish a single "notice" making the action effective.

c. Abbreviated rulemaking

This framework process would be used to adjust most of the management measures contained within Amendment #4. Actions proposed through this procedure will be considered to be "routine", or will have a permanent effect and which are discretionary, for which the impacts have not been previously assessed. The Council will develop and analyze the proposed actions over the span of at least two Council meetings, and provide advanced public notice of the availability of both the proposals and the analyses. Opportunity to provide written and oral comments will be provided throughout the process before submitting the recommendations to the Regional Director. It is very likely that the Council will convene and consider the advice of the PDT and Industry Advisory committee during this process.

If the Regional Director approves the Council's recommendations, the Secretary is expected to waive for good cause the requirement for a proposed rule and opportunity for public comment in the *Federal Register*. The Secretary, in so doing, will publish a "final rule" to remain in effect until amended. Submission of recommendations does not preclude the Secretary from deciding to provide additional opportunity for prior notice and comment in the *Federal Register*, but it contemplates that the Council process will adequately satisfy that requirement.

d. Full rulemaking or regulatory amendment

Future actions proposed through this procedure are considered to be highly controversial or makes direct changes in resource allocation. Several management measures which would directly result in a reallocation of the scallop resource or which were not preferred are included as framework measures for future consideration. The impacts of these actions generally fall outside the scope of impacts previously analyzed, but new analyses will be performed and considered during the framework process. The Council will follow the process established for abbreviated rulemaking, but additional deliberations and opportunity for comment is expected. The Secretary will published a proposed rule with an appropriate period for public comment, followed by publication of a final rule.

Frameworks and proposed management measures

a. Routine framework

"Routine" management measures are those that the Council determines are likely to be adjusted on an annual or more frequent basis. Future recommendations of measures to be

considered as "routine" will be made through the full or abbreviated rulemaking process. Measures determined to be of this type will address the issue at hand and may require further adjustment to achieve its purpose with accuracy. "Routine" measures may be modified through a single meeting and "notice" procedure only if 1) the modification is proposed for the same purpose as the original measure, and 2) the impacts of the modification are within the scope of the impacts analyzed when the measure was originally classified as "routine." The analysis of impacts need not be repeated when the measure is subsequently modified, if they do not differ substantially from those contained in the original analysis. The Council may also recommend removing a "routine" classification.

Days at sea adjustments due to vessel attrition (notice action)

Vessel operators may tender their permit for an entire permit year in order to fish in other fisheries without being subject to scallop regulations. Since the number of scallop vessels that have active limited access permits will be known in advance, the Council may consider changes to the days at sea allocations and to allow the remaining vessels to fish at higher levels without undermining the rebuilding schedule. This adjustment would be temporary, and would extend for a maximum of one year. Alternatively, sea scallop permits may be purchased to permanently tender its days at sea allocation. Under this provision, the permit's effort allocation will be redistributed among the remaining limited access vessels. The impacts associated with this temporary adjustment are similar to those analyzed for adjustments to the effort reduction schedule and are analyzed and considered in Amendment #4.

During October through December, vessels will declare their intent to scallop during the following year. In January, therefore, the Regional Director will be able to report the number of tenders, buy-backs, and non-declared vessels within each days at sea group. The Council may reallocate the days at sea to vessels based on the allowable total days at sea and the number of limited access vessels for that year.

Adjustment mechanism and formula: Beginning in 1996 and annually thereafter, the DAS allocated to occasional, part time, and full time vessels will be based on the total DAS specified under § 650.25 but shall be adjusted for failure to renew limited access permits and for permanent limited access permit tendering. After the close of the application period (December 31 preceding the calendar year for the annual permit), the Regional Director shall determine the number of vessels issued permits in each limited access category. These totals will include the potential participants that may gain access through appeals or legal actions that are initiated by the close of the application period. The Regional Director shall prepare a report indicating the number of vessels in each category and the proposed DAS limits based on the formula in (1). This report will be given to the Council at its first meeting following January 15. The Council will consider the information presented and may recommend DAS adjustments based upon the report. If the

recommendation is approved, the Secretary will publish a single "notice" in the Federal Register making the action effective.

The vessels in each limited access category will be allocated DAS based on the following formula, unless the result is less than the vessel's allocation as provided in § 650.25:

Equation **(6)**:

DAS_grp_yr ~= ~ { LEFT[{ LEFT({F_tgt_{(yr-1)} - ~{(F_tgt_{(yr-1)} - ~F_{5%})} OVER N} OVER F_1990 RIGHT) ~* ~P ~* ~SUM 1990DAS ~* ~LEFT({SUM DAS_qual} OVER {SUM DAS_qual_yr} RIGHT) } OVER {SUM DAS_qual} RIGHT] } ~* ~OVERLINE DAS_grp

where:

DAS_grp_yr - Days at sea to be allocated to each vessel in category grp and in year yr.

F_tgt_{(yr-1)} - Target fishing mortality for the preceding year, yr-1.

F_{5%} - Overfishing definition fishing mortality derived from the exploitation pattern of the gear in use during year yr.

N - Number of remaining effort reductions that are scheduled. For 1995, N = 4; for 1997, N = 3; for 1998, N = 2; and for 2000, N = 1. For 1996 and 1999, the scheduled effort reduction $\{(F_{tgt(yr-1)} - F_{5\%}) / N\}$ is equal to zero.

P - Fishing effort and fishing mortality proportionality constant, initially assumed to be 1.0. This constant shall be re-evaluated during the pause years, 1996 and 1999, or more frequently after 1996 under section [CITE].

SUM 1990DAS - Total days at sea directed (greater than 400 pounds per trip) for scallops during 1990.

SUM DAS_qual - Sum of the days at sea for each limited access vessel's qualification period (§ 650.25) which are issued permits during 1994.

SUM DAS_qual_yr - Sum of the days at sea for each limited access vessel's qualification period (§ 650.25) which were issued permits during 1994 and which are being issued renewal permits for year yr.

OVERLINE DAS_grp - Average of the qualifying days at sea for all limited access vessel in each category grp which was used to determine classifications in 1994.

Examples: Two examples are given in the following tables. Table 46 contains the expected results when 5 percent annual attrition occurs in all groups. Table 47 gives the expected results under 10 percent annual attrition of only occasional classified vessels. In both cases, the unutilized effort from vessel attrition would be distributed to the occasional, part time, and full time groups in the same proportions as the original allocations. If attrition occurs in all effort groups, a part time vessel during 1998 would receive 70 DAS, and would be calculated as:

Equation :
DAS_grp_yr ~= ~ { LEFT[{ LEFT({1.34 - ~{(1.34 - ~0.97)} OVER 2} OVER {1.63} RIGHT) ~* ~1 ~* ~48,253 ~* ~LEFT({51,736} OVER {42,140} RIGHT) } OVER {51,736} RIGHT] } ~* ~86.94

Under the case when attrition is confined to the occasional vessels, a part time vessel would receive 82 DAS. Because 1996 allocations of DAS were specified by the mortality reduction schedule rather than fixed limits, as in 1994 and 1995, the calculated days at sea would be 76 and, therefore, the DAS limit for part time vessels would not be reduced below the limits specified under § 650.25.

Justification and Analysis: Failure to redistribute effort created by permanent vessel attrition, would deviate from the effort and mortality reduction schedule and would cause greater impacts than analyzed within the FSEIS. In an extreme case where most of the active fishing vessels with limited access permits were unable to cover fixed costs in the short term, the fishery might close because of the extra economic burden. The levels of fishing effort necessary for vessels to cover their fixed costs in the short term is provided in the FSEIS. If this were to occur, a re-allocation of unutilized DAS would allow the remaining vessels to fish at higher levels and stay economic. Since this framework adjustment would restore fishing mortality the FMPs original schedule, the range of outcomes due to the adjustment mechanism has been analyzed within the FSEIS.

Days at sea adjustments due to changes in fishing mortality (abbreviated rulemaking)

Adjustments to days at sea caused by observed changes in fishing mortality are anticipated after the pause years (section V.C.3). If days at sea have been reduced to appropriate levels according to the rebuilding schedule but F remains higher than anticipated, then the days at sea schedule will be adjusted downward. This outcome can be expected if, for example, fishermen significantly improve their effective fishing effort per day at sea. On the other hand, F could be lower than anticipated if vessel attrition is greater than expected or fishermen don't increase fishing effort to match the limits on days at sea (section VII.A.2.b). The days at sea schedule might be relaxed in this case. After the first re-evaluation, the Council expects enough available information to enable annual adjustments to adhere to the established fishing mortality schedule. The scope of probable impacts due to mis-specification of the effort mortality relationship have been analyzed and considered in sections V.F.2 and VII.F).

Shell height (abbreviated rulemaking)

One of the potential, unanticipated effects of Amendment #4 might be a switch to shell

stocking during periods of high scallop abundance. During these times, the shucking capacity of a nine or five man crew is limited by the size of the scallops. This management measure is intended as an age at entry control to delay harvest, improve spawning stock biomass, and improve yield per recruit. If vessels switch to shell stocking, it might undermine the objectives of the FMP. The proposed 3½ inch shell height may not be effective in limiting a switch to shell stocking and an avoidance of the crew size limitation. Under these circumstances, the Council might consider changes to the shell height regulation so that it matches the age at entry objectives projected by limits on crew size. Since the anticipated impacts of Amendment #4 do not include an increase in shell stocking, adjustments to this measure to maintain current practices are within the scope of analyzed impacts.

Effort monitoring (abbreviated rulemaking)

Effort monitoring through vessel tracking systems (section V.E.9) or call-in programs (section V.G.7) are included in Amendment #4, depending on the group categories. Adjustments to this management measure may be necessary for technical reasons. For example, if one segment of the fleet is given the option to use a call-in program but only ten percent of that group uses that method, the Council might consider a requirement that all limited access vessels use vessel tracking systems. Since a variety of effort monitoring systems are analyzed by Amendment #4, changes to the effort monitoring system have already been analyzed and considered.

Permitting rules (abbreviated rulemaking)

Certain technical changes to the permitting procedures may be necessary to allow efficient administration, to improve enforcement through permit sanctions, and to identify participants for mandatory data collection.

Data reporting (abbreviated rulemaking)

Certain new data elements might be desired within the mandatory data reporting system that were not provided during initial implementation of Amendment #4. Required reporting of these new elements or a differing method of reporting, e.g. using vessel tracking systems to report logbook data, might be considered to provide adequate information to adjust other management measures.

Offloading windows (abbreviated rulemaking)

Offloading windows will be discontinued because the previous meat count regulation will not need enforcement. During development of Amendment #4, enforcement agencies preferred retaining the offloading windows for enforcement of the new regulations. If they

prove to be unenforceable during periods outside the previous offloading windows, then the Council would consider reinstatement of this measure. Because of its long history of usage in the fishery, the associated impacts are considered within the non-preferred alternatives (section V.G).

Other monitoring and enforcement measures (abbreviated rulemaking)

Some technical changes having negligible impact may be necessary to allow better monitoring and enforcement. Requirements to make logbooks or catch available to authorized agents or to allow unhampered and randomized sea sampling might be considered under the "routine" framework.

b. Points of concern framework

The Council's scallop PDT will monitor the fishery and the management program. Following the guidelines in 50 CFR 663 for this framework, the Council would make recommendations to the Regional Director for changes in the management program. In identifying resource conservation issues and "points of concern", the Council will consider any change in the biological characteristics of the species or stock complex and whether recruitment is substantially below replacement level. The biological considerations will include updated information on growth, natural mortality, size at maturity, reproductive behavior, larval distribution and settlement, and the relationship between spawning stock and recruitment. Information concerning stock structure, fishing mortality, recruitment to the fishery, and stock abundance will also be considered.

Ring or mesh size (abbreviated rulemaking)

Ring size in dredges and mesh size in trawls are intended as a primary control on the size of harvested scallops. These measures have a significant bearing on spawning stock biomass and on the threshold fishing mortality rate established by the overfishing definition. Research into the effectiveness of ring size and mesh size in limiting the harvest of small scallops is recommended. Once this information is available, the Council might recommend changes to these restrictions through the appropriate framework process.

Other gear restrictions (abbreviated rulemaking)

Amendment #4 includes a prohibition on chafing gear, cookies, more than double linking, or other obstructing devices within the scallop dredge. Although this measure restricts most gear modifications that would allow the capture of small scallops, the points of concern framework would allow the Council to respond to unanticipated changes in scallop gear.

Vessel based mechanical processing (abbreviated rulemaking)

Sorting and shucking machines are prohibited from certain vessels to limit on-board processing capacity that would undermine the intent and effectiveness of the crew size limits. The Council may consider other measures that restrict mechanical processing on-

board scallop vessels if they undermine the effectiveness of the management measures.

Overfishing definition (abbreviated rulemaking)

The overfishing definition for Atlantic sea scallops (section F.1) provides a more detailed description of the basis and procedures for changing the overfishing definition. The recommendations to change the 5% MSP level would be made through abbreviated rulemaking.

General category trip limit (full rulemaking)

The general category trip limit of 400 pounds of scallop meats or 50 U.S. bushels of shell stock was based on current resource conditions and harvesting practices. As resource conditions change, more fishermen may be able to make profitable trips and increase effort within the general category moratorium exemption. If these changes are substantial, the effort reduction imposed on limited access vessels would become less effective in controlling fishing mortality. If this occurs, the Council may consider and recommend changes to the general category trip limit instead of further limiting effort by limited access vessels. Since this action would cause direct changes in resource allocation, adjustments to this measure would be recommended through full rulemaking.

c. Socio-economic framework

Non-biological issues may arise that cause the Council to recommend management actions to address social or economic issues. These recommendations would be made through the framework procedures to achieve the stated social or economic objectives of the FMP. In making these recommendations, the Council will follow the guidelines established by the socio-economic framework in 50 CFR 663. The Council will prepare a report containing the rationale for the recommended actions by convening the Industry Advisory committee or the PDT to develop or review the report.

Dredge width or trawl sweep limits (abbreviated rulemaking)

Adjustments to these limits would benefit certain segments of the fleet, protect localized resource areas from non-prevalent fishing activities, or allow more time at sea by reducing effective fishing power. More research would be needed to define the latter relationship, but the Council may consider adjustments if such information were available.

Crew size (abbreviated rulemaking)

Crew size can be an effective limitation on the harvest of small scallops. Nonetheless, the Council may consider adjustments to crew size to address safety issues or to mitigate increases in effective fishing power through processing innovations.

Mesh size area restrictions (full rulemaking)

Because there are different mesh regulations for finfish trawling throughout the management unit for sea scallops, vessels trawling for scallops south and west of Hudson Canyon will be permitted to use 5 inch mesh for the first two years following implementation. Modifications to the boundary may be necessary to coordinate mesh regulations with other fisheries if the five inch mesh is found to limit the catch of small scallops to levels controlled by restrictions on dredges. Alternatively, an extension to the exception due to prevailing resource conditions may be required if few large sea scallops would be available to the larger mesh at year three.

Allocation of days fishing instead of days at sea (full rulemaking)

Monitoring and limiting days at sea is expected to cause differential impacts on vessels from various ports. It also is expected to induce vessels to relocate closer to productive fishing grounds whenever possible. These unintended effects do not contribute to the intent of Amendment #4, but monitoring and limiting the number of fishing days is not technically possible. If future technological developments allow monitoring of days fished, the Council might recommend changes to the effort monitoring system to reduce the unintended effects.

Moratorium rules (full rulemaking)

If fishing effort and fishing mortality declines faster than anticipated and stock conditions improve, the Council may consider the alternative of relaxing the moratorium rules and allowing new entrants instead of allowing more days at sea to a small group of participants. This outcome might be expected if substantial numbers of qualifiers exit from the fishery or to provide for fishery participation by future generations.

Group definitions (full rulemaking)

Some unanticipated inequities in the current form of effort allocation may become apparent following implementation. Either the threshold participation levels or the number of groups could be reconsidered to reduce the social impact and improve economic efficiency through a framework adjustment.

Limited access trip limits (full rulemaking)

Trip limits for limited access vessels were considered as a non-preferred alternative during the development of Amendment #4. When changes to effort restrictions are considered, trip limits may be recommended to improve economic performance, e.g. evenly distribute seasonal landings, rather than force further restrictions through reduced days at sea

allotments.

Layover day requirements (full rulemaking)

This non-preferred management measure could have similar effects as explained above and might be considered as an additional measure to the individual days at sea restrictions.

Closed seasons (full rulemaking)

Closed seasons may be considered to reduce the catch of newly recruited, small scallops to improve yield per recruit. This measure may also be considered to control an increase in effective fishing power created by seasonal shifts in fishing effort which would translate into higher fishing mortality. The former rationale would justify a temporary closure, while the latter might require a more permanent regulation.

Closed areas (full rulemaking)

Closed areas would be considered to protect localized concentrations of small scallops from pre-mature exploitation.

Fishery quotas (full rulemaking)

This management measure would impose a total annual (or another period) quota on the fishery. Fishing would be prohibited once the quota was reached. This management measure was generally opposed early during the development of Amendment #4. Nonetheless, future resource conditions, better predictability of future biomass from the survey data, and changes in the fishery economics might justify using quotas in lieu of adjustments to other management measures to achieve the plan's objectives.

Vessel quotas (full rulemaking)

The rationale for this management measure is similar to fishery quotas, except it does not retain a competitive incentive to overcapitalize the fishery. Vessel quotas would have similar characteristics to individual vessel days at sea allocations, but would not require other constraints on effective fishing power.

§ 850. Data Requirements

Amendments to add to existing language:

Data Reporting

This amendment would establish a new data collection and monitoring system to achieve the objectives through the management measures. The system may require some real-time data collection, and will combine proposed mandatory VTS/call-in, weigh-out, sea sampling, vessel permit, captain permit, buyer (dealer, broker and processor) permit and enforcement monitoring information. Discussion of data collection is found in section V.B.E.7 of the SEIS and § 822.

The data system will provide the information required to adjust management measures, such as 400 pound trip limits, days-at-sea or gear restrictions, under the framework mechanism (see section 842). The new database will facilitate development of a statistically based sampling system for inspecting any scallop vessel or dealer. It also will be designed to limit access to enforcement files only to properly authorized agents/employees of the federal government.

To support the development of the database the following requirements will be implemented by the Amendment:

> Sea scallop fishery buyers must obtain a permit and will be liable for violations of the management measures where appropriate;
>
> Fishermen and buyers (dealers,brokers, and processors) will be required to report data needed to monitor the scallop fishery;
>
> Fishermen and buyers will be responsible for the purchase/lease of the necessary equipment (credit-card machines, transponders, etc.)

A dual-reporting scheme, by both fishermen and buyers, may be necessary to record all landings data, by both limited access and general scallop permit vessels. However, the Council has decided that implementation methods would be developed by the National Marine Fisheries Service, but including members from all PDT's and outside NMFS (see Appendix IV to the SEIS, Mandatory Data Collection).

Landings and effort data are specified in § 822, and may include descriptive parameters such as stock areas, ports landed, gear-type, vessel, etc. Information required by various permits is specified in § 823. Other items are mentioned in the Report on Resource Status in § 824. Several important areas of monitoring not included in other sections are:

<u>Commercial Catch Size via Sea Sampling:</u> The average size of scallops landed under the effort control program must be measured on a routine basis, however, this activity must not be misconstrued as a continuation of the meat count standard. The purpose of such monitoring is to enhance the ability to measure fishing mortality during the pause years, or at other appropriate times.

Scallop Boats' Financial Status: It is not expected that any vessels will permanently leave the scallop fishery because of the effort control program. However, the number of and reasons for limited access vessels' leaving permanently the sea scallop fishery must be monitored. See section 842, Average Days-at-sea adjustment due to vessel tenders/buy-backs.

Scallop Import Monitoring: The volume and prices of scallop imports and their relationship to domestic landings and prices, as well as the general economic condition of the fishery, will be monitored and analyzed during the third year of the plan.

Resource Monitoring (see Overfishing Definition): Adjustments to management measures may be made based on updated biological characteristics of sea scallops. Parameters such as recruitment, size-at-recruitment, commercial gear selectivity, culling practices, and landings of Atlantic sea scallops shall be considered annually. Survey information on maturity, indices of abundance, and resource assessment are also needed annually, during and after the third year of the plan.

§ 860. Recommendations for Environmental Conservation and Investigations for Scallops

Amendments to add new section:

Amendment #4 contains a number of provisions, including significant reductions in fishing effort, to eliminate the overfished condition of the sea scallop resource and reduce the risk of recruitment failure. Although fishing is responsible for most adult sea scallop mortality, it would be unfair to impose burdensome fishery controls without ensuring pollution and habitat degradation does not negate any gains made by Amendment #4. While the Council has the authority to develop fishery management programs that control fishing mortality through the Magnuson Act, conservation of critical habitat is equally as important. Although the primary responsibility for protecting habitat lies with the Environmental Protection Agency and the Corps of Engineers, Councils may comment on and make recommendations concerning any state or federal activities that, in the view of the Council, may affect the habitat of a fishery resource under its jurisdiction. In accordance with §302(i)(2) of the Act, federal agencies shall within 45 days provide a detailed response in writing addressing the Council's concerns. Fishery managers and habitat protection agencies need to enhance communications regarding actions that impact coastal habitat and the marine environment in order for fishery management efforts to succeed.

According to the NMFS Habitat Conservation Policy (FR 48(228):53142-53148), Councils should include habitat considerations in FMPs. These considerations are described in sections VI and VII. The policy states that NMFS is required to systematically consider

Council recommendations and is authorized to acquire the basic knowledge necessary to meet the Council's needs (§304(e) of the MFCMA).

Because information is inadequate in some cases to evaluate scallop habitat issues, the Council makes the following recommendations for environmental conservation and proposes investigations to collect necessary data.

1. Environmental conservation

Dumping of dredged materials, sludge, or industrial waste into areas which form the most productive bottom for scallops (Figure 3) should be prohibited. Specifically, heavy sedimentation has a direct effect on scallop ecology by covering suitable habitat for spatfall (Section VI.B.4) and by decreasing feeding activity of adult scallops (Section VI.F.3.b). Concentrations of trace metals, such as cadmium and copper, whether suspended or interstitial, also are problematic (Section VI.F.1.a).

The appropriate level of contaminants should be considered when assessing the suitability of sediment destined for ocean disposal. Federal agencies are charged with protecting and even enhancing the health and availability of our nation's Public Trust Resources. To achieve these goals, the above criteria need to be followed closely to preserve living marine and estuarine resources.

Monitoring required under 40 CFR 228.10 should take into account both short-term and long-term environmental effects. Impacts occurring before, during, and following the disposal activity and long-term or cumulative environmental changes should also be evaluated.

Most dredged material disposal sites are located well inshore of scallop habitat, with the exception of the Gulf of Maine. The problems related to dredging and dredged material disposal are similar to those indicated in Sections VI.F.3.b and VI.F.4. In general, dredged material disposal should be prohibited in areas of significant scallop concentrations. Dredge types should be selected that will minimize operational environmental disturbances. Dredged material disposal should be controlled to protect vital habitats and estuarine water quality. Alternatives should be sought to open-water disposal of contaminated materials or special handling techniques should be incorporated to confine contaminated dredged materials.

The Massachusetts Bay Industrial Waste Site should be studied by the EPA to determine whether the IWS material is having or has had any effect on the Massachusetts Bay ecosystem, and to determine whether remedial action should be undertaken.

Dumping that significantly impacts nutrient loading over the continental shelf should also

be avoided. Although dilution occurs and the dumped products are redistributed via oceanic currents, localized anoxia, concentrations of trace metals, and pollution that can trigger blooms of organisms that release toxins that have deleterious effects on scallop beds.

2. Environmental investigations

The Council supports the initiatives of the National Status and Trends Program of NOAA to monitor and potentially identify long-term, seemingly innocuous changes in the environment. Although much of this research does and should focus on the interaction between pollution, coastal alteration, wetlands, and their use as spawning and nursery areas, these investigations should be expanded to include ocean waters of the continental shelf. Specific issues regarding sea scallop habitat and environmental quality should be examined including:

1) Programs that emphasize long-term synergistic effects of combinations of environmental influences that are likely to affect reproduction, larval and spat mortality, genetic fitness, and suitability for human consumption. The Council encourages better integration of U.S. and Canadian research efforts to assess environmental influences on transboundary scallop populations.

2) Studies that focus on the finer scale resolution of impacts that may control viability of localized scallop beds, including the combined effects of contaminants and environmental perturbation which affect the pathology of scallop larvae, inhibition of spatfall, and feeding of adult scallops. In particular, the direct and indirect effects of suspended sediments and siltation, uptake and concentration of heavy metals, and the effects of nutrient loading that could cause blooms of undesirable organisms, such as those that produce toxins causing paralytic shellfish poisoning should be investigated. For example, organic enrichment could be particularly problematic on Georges Bank because coastal waters in the Gulf of Maine are entrained in gyral currents which move south to productive scallop beds.

   Disposal of fish waste in the Gulf of Maine has been conducted under the auspices of the EPA with the concurrence of NMFS and adjacent states. Because impacts of these activities have neither been documented nor evaluated to date, studies should be initiated to determine real or potential adverse impacts to scallop habitat.

3) Recruitment mechanisms should be investigated. In particular, regions that are self-sustaining versus those which are dependent on other spawning grounds should be identified. Differential reproductive potential of regional populations, and the importance of unharvestable areas as refugia should be investigated. If detailed,

large-scale bottom topography and geologic mapping becomes available, the Council supports research to assess the value of unfishable populations to spawning and its potential impact on the overfishing definition.

The environmental characteristics that promote enhanced recruitment require investigation. It is clear that certain oceanographic conditions lead to periods of high recruitment. Early identification of these periods has the potential for improving management. Further investigation into spawning frequency and fecundity is needed. For example, the relative viability of larvae from dual spawning events in the southern portion of the range is unknown.

4) Selectivity studies are necessary to evaluate the affect of ring size and gear restrictions on scallop age at entry and associated by-catch. This information is required to make accurate adjustments in the effort reduction program after year three and to eliminate overfishing by year seven. In addition, further conservation engineering research is needed to better assess the impact of scallop and hydraulic dredges on nearby populations of benthic organisms. Recent studies have suggested that scallop dredging results in measurable physical impact to the ocean floor. Impacts of this gear on scallop habitat as well as on the habitat of other commercially valuable species should be evaluated.

5) The current assessment methods utilize a modified DeLury method (Conser 1991) because of insufficient data to support a full age-structured assessment. While this method provides reasonable results, it is sensitive to several important assumptions including availability and catchability of scallops in survey dredges. Scallops assessments would benefit from a more comprehensive and rigorous commercial catch sampling program designed to provide catch at age data.

6) Fishable concentrations of sea scallops in some areas overlap with several species of marine mammals and sea turtles. Researchers have indicated that the average tow times for scallopers using trawls was significantly greater than that stated in the draft documents. It is well documented that long tow durations in other trawl fisheries adversely impact marine mammal and sea turtle survival. If scallop trawling expands into areas having more frequent concentrations of endangered or threatened species, the longer tow durations may become an issue. NMFS should consider observer coverage aboard scallop trawlers where co-occurrences of endangered or threatened species potentially exist. This monitoring will assure early determination of interactions with endangered species.

§ 920 Consistency with National Standards for Fishery Conservation and Management

Amendments to replace existing language:

Section 301 of the Magnuson Act establishes seven National Standards with which all FMPs must be consistent. The measures and provisions of the Atlantic Sea Scallop Fishery Management Plan are consistent with these National Standards in the following manner:

1. Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

The Council believes the proposed action (section V) will allow the resource to recover from its overfished condition while minimizing impacts on fishermen (section F.1). Overfishing in the Atlantic Sea Scallop FMP is defined as a fishing mortality rate that, if continued, results in a spawning stock biomass (SSB) of five percent of the maximum spawning potential. This fishing mortality rate ($F_{5\%}$) is estimated to be 0.97 for a fishery using dredge and trawl gears limited by the management measures (sections V.E.6 and V.E.7). According to the latest assessment (NMFS 1992), the average fishing mortality rate weighted by relative abundance is 1.63. Thus, the sea scallop resource is overfished.

At the time of the assessment, stock abundance and SSB were high because of several years of exceptional recruitment. Over a much longer period, however, the current exploitation rates are expected to result in a SSB of only 2.3% compared to an unfished population. More recent research surveys, declining landings, and reports by fishermen indicate lower recruitment and a rapidly declining biomass due to high exploitation.

The Council proposes to reduce fishing mortality below $F_{5\%}$ over a seven year period. This schedule of effort reduction and gear limitations is expected to produce rapid and substantial increases in SSB compared to levels expected with no change in management (Figure 47).

Maximum Sustainable Yield (MSY) has not been defined for Atlantic Sea Scallops. F_{max}, the fishing mortality rate that will produce the greatest yield per recruit is estimated as 0.18, a value substantially below current F. In order to reach F_{max}, fishing mortality and fishing effort (if linearly proportional between current F and F_{max}) would have to be reduced by 89% Since the primary objective of Amendment #4 is to eliminate overfishing, greater reductions in fishing mortality and higher yield per recruit were not evaluated. There is a real possibility, however, that greater reductions in fishing mortality would create more opportunities for imported scallops and cause negative net benefits. After fishing mortality is reduced below the overfishing threshold, further management goals may be reevaluated based on the fishery at that time.

The Council evaluated fishery capitalization, employment, potential for imports,

economics, and social ramifications (section VII) while developing a fishing mortality schedule. Very little recreational opportunities exist for this fishery and the proposed action will not enhance or detract from it. The proposed action is estimated to produce a cumulative, discounted net benefit of $114 million over No Action (section VII.F.3.c) over 15 years. Optimum Yield (OY), therefore, is defined as the biomass of scallops harvested by the fishery pursuant to the rebuilding schedule and this FMP.

2. Conservation and management measures shall be based upon the best scientific information available.

The latest assessment (NMFS 1992) provided data on the current status of the resource. This assessment was completed for the stock components in the South Channel, the Southeast Part of Georges Bank, and the Delmarva areas through mid-1991. Because of technical factors or incomplete survey coverage, the stock components in the Gulf of Maine, the Northeast Part of Georges Bank, and in New York Bight were not included. To evaluate the impacts of alternative measures, landings data through 1991 were used. At the time, this weighout data was the latest available information. Since the initial draft and the final round of public hearings, landings data for 1992 have become available. The relative level of participation and the fishery performance have changed little from 1991, therefore the original analyses based on 1991 landings data has been retained. Much of the biological information and ecological characteristics of sea scallops were derived from Shumway (1991) and other recent publications. Information about the fishery and processing sector came from Sutinen et al. (1992). The social data and evaluation was conducted during 1992 under contract to the Council.

The moratorium is based on vessel participation during 1988 and 1989 (March 2, 1990 for new or re-rigged vessels). This action is based on a March 2, 1989 control date and takes into account recent participation in the fishery. Newer fishery participants are considered to be speculative entrants according to the control date ruling. All new entrants were notified of the potential impact of the control date on continued participation. Because a vessel's fishing activity changes from year to year, the Council considered several formulations to allocate effort (Appendix II). The period of 1985-1990 was chosen because it took into account this variation and would not penalize the consistent participants by relying on 1991 or 1992 when a minority of vessels made back-to-back trips (no layover time between successive trips).

The proposed action includes two forms of mandatory data collection for monitoring the fishery. Days at sea must be monitored for all limited access vessels. The most efficient and cost-effective means to accurately monitor days at sea is by using on-board transponders (section V.E.9). This monitoring system will be required on full-time and part-time vessels. Occasional vessels will be given the option of using the transponders or a call-in system. The cost associated with the effort monitoring programs is evaluated in

section V.F.4.c.

Throughout the development of Amendment #4, the Council has been hampered by incomplete landings data collection. Because of incomplete data, many of the proposed measures and the appeals process were modified to ensure equitable allocation of fishing rights under the moratorium and group allocation systems. Without these modifications, many vessel owners, especially those from Maine and North Carolina, would have been forced to present detailed records of fishing activity in order to qualify. The impact of these modifications on the net benefits has been included in the final analyses, and the cost associated with the appeals is estimated (section V.F.4.a). An accurate assessment of fishing mortality and total days at sea is crucial to make accurate adjustments to future allocations of days at sea during year three. Therefore mandatory data collection is a necessary element of management.

3. To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

The FMP defines the management unit as the entire EEZ and coastal waters from Maine through North Carolina. Although there are some small differences in biological characteristics and spawning within this range, scallops are broadcast spawners with pelagic larvae. There is little evidence of reproductive isolation and the spawning stock of an area most likely contributes to the entire resource. Furthermore, the scallop fleet is highly mobile. Maine vessels often migrate to Cape Cod and scallop in areas surrounding Georges Bank. Mid-Atlantic vessels range as far as Georges Bank and New Bedford vessels sometimes fish in the Mid-Atlantic. Therefore, the Council finds that there is little justification for separate, regional sea scallop populations within the management unit. Fishing mortality for sea scallops is therefore defined as the abundance-weighted average of fishing mortality within all stock components.

With the exception of vessels not having federal permits and who fish for scallops exclusively in state waters, the sea scallop resource is managed uniformly throughout the range in U.S. waters. State permitted vessels which scallop in state waters will only be exempt from certain management measures, e.g. days at sea limits. Therefore, the landing and possession limits would preempt state regulations where they exist. Gear restrictions will only apply to vessels scalloping in the EEZ or which hold a federal scallop permit. Fortunately, the proposed actions are no more restrictive than existing state regulations (Table 12).

The biological range of the Atlantic sea scallop stock extends into Canada's jurisdiction, at least as far as the Northeast Channel of Georges Bank. These populations in Canada probably contribute to the spawning potential of the resource, but due to more restrictive

management the scallops in this region are significantly older (Mohn et al. 1989) and have greater opportunity to spawn than U.S. scallops. There is, therefore, no biological basis to suggest that separate management of sea scallops outside U.S. jurisdiction will have a negative effect on the U.S. sea scallop resource.

4. Conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

The interrelated bioeconomic factors in the sea scallop fishery, including no biological basis for subregional management units, high fleet mobility, and interregional economic relationships, make uniform regulation of sea scallops necessary. The FMP does not discriminate between residents of different states. It does not differentiate among U.S. citizens, nationals, resident aliens, or corporations on the basis of their state of residence. It does not incorporate or rely on a state statute or regulation that discriminates against residents of another state.

There are, however, indirect impacts that affect residents of states differently. Most of this differential impact arises from the allocation mechanism and from gear restrictions which differ from traditional ways of fishing. The proposed action allocates fishing rights in terms of days at sea to a limited number of pre-defined vessels. The Council believes that this form of effort allocation and monitoring will not place certain fishermen at a competitive disadvantage that did not already exist before the effort reduction program. A vessel's days at sea allocation will be based on a history which includes the extra transit time required for vessels in distant ports. These vessels may continue to fish from their ports and will not experience a greater reduction of days fished than closer vessels. These distant vessels can, however, land scallops at closer ports to optimize their days at sea. In so doing, these vessels may be impacted less by the management measures than other vessels.

Although it creates various regional impacts, this conservation measure has no discriminatory intent and promotes conservation. Because there may be some unavoidable inequities inherent in monitoring days at sea, the proposed action includes a framework provision to allow monitoring of days fished when it is made possible through technological improvements.

Analyses of this and other allocation formulations are presented in section VII.F.1. Some vessels will be forced to reduce fishing effort to the group allocation, e.g. a part-time vessel fishing 149 days in 1990 being reduced to 91 days in 1994, while other vessels will be able to increase fishing effort. Although certain vessels will experience significant impacts, the proposed three group allocation does not treat identifiable groups unfairly and is designed to achieve OY. The three group allocation of days at sea was chosen because vessels within large categories would receive the same number of days at sea and it would lessen the reliance on the voluntary weighout database. The Council also considered an alternative

having 22 allocation groups. While this form of allocation would lessen the impact on individual vessels that had fishing histories at the extremes of the three groups (section VII.F.1.b), the inadequacy of the voluntary weighout system created unacceptable burdens on fishermen to prove their accurate classification.
Other factors that were considered in compliance with §303(b)(6) of the Magnuson Act included, but was not limited to the historical dependence on scalloping (section VII.A.1), the impact on employment (section VII.C.1), the impact on coastal communities (section VII.C.2), the potential for displaced effort (section VII.A.2) and the future opportunities for new entrants. The Council recognizes that the moratorium will reduce fishermen's ability to switch between fisheries as stock abundance and economics change. The displaced effort created by disqualifying vessels and by reducing scallop effort is likely to affect other fisheries. Section V.A.2 indicates that much of the displaced effort will probably increase fishing pressure or affect existing management for monkfish, summer flounder, and to a lesser extent squid, mackerel, and butterfish. Regulated groundfish species are unlikely to be affected due to the management program being proposed by Amendment #5 to the Multispecies FMP.

The Council considered the impact on communities and historical practices when modifying the preferred alternative to allow vessels that use 10'6" dredges to qualify for a higher days at sea classification than vessels which use larger dredges. Although the use of small dredges is common in the Gulf of Maine, this option is available to scallopers from any state.

The proposed action specifically prohibits persons or entities from holding more than 5% of the limited access permits at implementation. Permit ownership can exceed this amount only through attrition of other vessels. The opportunity to enter the fishery exists for prospective participants through the purchase of a vessel which hold an existing limited access permit.

5. Conservation and management measures shall, where practicable, promote efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

A major provision of the proposed action limits directed fishery access to a pre-defined group of scallop vessels. Other measures are intended to cap total effective fishing power at manageable levels so that the schedule of effort reductions is effective in achieving OY. This allocation is proposed solely to restrict economic benefits for a restricted group, however the economic performance of the fishery is expected to substantially improve. Fifty-four percent of the expected increase in cumulative net benefits (section VII.F.3.f) arises from cost savings derived from decreases in fishing effort. Figure 41 shows the annual changes in cost savings, consumer surplus, and revenue when 1990 fishing mortality is 1.50. Similar changes in these values are expected for the currently estimated

1990 fishing mortality, equal to 1.63. As a result of the effort reductions and gear limitations, total landings (Figure 48) are expected to rise 22% above status quo levels. Coupled with the 40% decrease in fishing effort, catch per unit effort is expected to double (Figure 49).

Another source of improved efficiency results from the abolition of the meat count standard. Since crew limits and gear restrictions are expected to regulate the harvest of small scallops, these measures will make continuation of the meat count standard unnecessary. Much of the controversy surrounding the replacement of the meat count standard arises from enforcement problems and the burden on fishermen to comply (section IV.B). Both aspects are efficiency issues. Without a meat count measure, the current offloading windows become unnecessary and are removed by the proposed action. This action will allow fishermen to offload scallops at any time, potentially improving coordination with tidal fluctuations and prime market delivery times. The impact of this improved efficiency cannot be assessed.

Secondly, enforcement of scallop regulations will be improved by simpler determination of possession limits and by effort tracking via transponders. Although occasional vessels in the directed scallop fleet and many other vessels are not required to have on-board transponders while at sea, most of the directed vessels will be required to maintain operating transponders at all times. This will enable law enforcement to quickly locate scalloping vessels that have declared that they are not scalloping or have depleted their days at sea allocation. Lastly, fishermen will gain some efficiency by not being required to comply with a meat count. It will no longer be necessary to search for large scallops and to mix scallops at sea. In addition, the incentive to soak scallops to gain a lower meat count will be absent. Although soaking may still occur to increase landed weight, dealers will have a greater opportunity to offer higher prices for unsoaked scallops having higher product quality.

6. Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

The Council has accounted for variations and contingencies by choosing management techniques which allow fishermen to respond to stock abundance and economic conditions, and does not rely on annual estimates of abundance to set specific and precise management targets. The proposed action also includes frameworks that will allow adjustments to specific management measures (section V.E.11). By following the proposed framework procedures, the Council will be able to respond to changes in the fishery more rapidly than possible by amending the FMP. The impacts of habitat alteration have been identified (section VI) and specific recommendations have been included in the proposed action.

Scallop abundance and scallop markets have demonstrated wide variations over the past

thirty years. At various times, scallop landings have fluctuated between six and thirty-nine million pounds. Prices have ranged between $1.00 per pound when scallops were abundant and $5.00 per pound when they were scarce. More recently, imported scallops have become more competitive in the marketplace, especially at the medium to smaller meat weights.

The proposed action does not include any specific provisions to dampen the fluctuations in scallop abundance or in market demand. The proposed action is, however, anticipated to increase the abundance of larger scallops which contribute to spawning stock biomass. The action will achieve this through decreases in fishing effort in addition to crew limits and gear restrictions. Instead of simply delaying the age of capture by the fishery and fishing harder on each incoming year class, the action is expected to result in several year classes being available to the fishery. While this won't eliminate the natural resource fluctuations, it will decrease the rate of change and improve the ability of fishermen to anticipate changes in future stock and revenue.

The preferred management action is superior to the non-preferred alternatives because it accounts for flexibility of fishermen to respond to changes in stock conditions, weather, and economics. A days at sea allocation will allow fishermen to fish at optimal times to maximize their economic return. This may include making frequent, back-to-back trips if conditions warrant. Vessels that do so, however, will have to balance this action against the loss of scallop revenue at other times of the year. The alternative trip limits and lay-over days would require fishermen to spread their effort seasonally and may cause fishermen to sail during poor weather conditions.

In addition, the proposed form of allocation does not rely on an estimate of short-term stock abundance as required by quota setting (sections V.G.4, V.H.4, and V.H.5). The schedule of days at sea allocations is expected to remain the same regardless of prevailing stock conditions. The net benefits and marginal changes in yield are estimated to be very similar regardless of future recruitment success (section VII.F.2.a). This stability in future allocations of fishing effort will allow fishermen to better anticipate their equipment and supply needs.

7. Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

The need for management of the sea scallop fishery was established by implementation of the FMP in 1982. The proposed action amends the FMP to better achieve its objectives. This action does not impose significant burdens on fishermen for choosing when to fish, how to procure supplies and equipment, or when to bring scallops to market. In fact, the proposed action replaces a meat count standard which imposed burdens on the size of

scallops that could be harvested and marketed, as well as burdens associated with compliance. The administrative costs of the proposed action are identified in section V.F.4. These costs will replace those associated with enforcing the meat count standard and do not outweigh the expected gain in net benefits (section VII.F.3.f).

XIV. LIST OF PREPARERS

Amendment #4 to the Atlantic Sea Scallop Fishery Management Plan was prepared by a committee of Council members, a Plan Development Team, and other scientists and managers with expertise in the scallop fishery.

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XV. GLOSSARY

ADF - Atlantic demersal finfish are ten species (Table 18) which are usually caught with large mesh trawls and are regulated under the Multispecies FMP.

ASMFC - Atlantic States Marine Fisheries Commission

ATM - automatic teller machine.

Abundance index - A relative measure of the number of animals in a population determined by sampling.

Act - Magnuson Fishery Conservation and Management Act.

Age at entry - age or size when a scallop is first caught by fishing.

Biological Reference Points - Fishing mortality rates that may provide acceptable protection against growth overfishing and/or recruitment overfishing for a particular stock. They are usually calculated from equilibrium yield per recruit curves, spawning stock biomass per recruit curves and stock-recruitment data. Examples are $F_{0.1}$, F_{max} and F_{med}.

CFR - Code of Federal Regulations.

CPUE - catch per unit (fishing) effort**.**

Consumer Surplus - What consumers are willing to pay for a good minus what they do pay.

Council - New England Fishery Management Council.

DAH - Domestic Annual Harvest; a term in the Act.

DAP - Domestic Annual Processing; a term in the Act.

DOC - (U.S.) Department of Commerce.

Discount Rate - The rate at which future benefits and costs are discounted to find their present values.

Dredge - Metal framed apparatus with a metal ring bag that is towed behind a vessel on

the sea bottom to collect scallops.

EEZ - Exclusive Economic Zone; the area covering and extending 197 nautical miles from the seaward limit of the States' territorial waters subject to U.S. jurisdiction.

EPA - Environmental Protection Agency

ESA - Endangered Species Act

Economic Rent - Any payment to a factor (i.e. labor, capital, land, etc.) in excess of its opportunity cost.

Exploitation Rate - The proportion of a population at the beginning of a given time period that is caught during that time period (usually expressed on a yearly basis). For example, if 720,000 fish were caught during the year from a population of 1 million fish alive at the beginning of the year, the annual exploitation rate would be 0.72.

Ex-vessel price - Price of fish (product) to the fisherman (boat) at first transaction.

FDA - Federal Drug Administration.

FMP - Fishery Management Plan

Fathoms (fm) - Measure of water depth, 1 fathom = 6 feet = 1.83 meters.

Fishing mortality rate (F) - The part of the total mortality rate applying to a fish population that is caused by fishing. Fishing mortality is usually expressed as an instantaneous rate, as discussed under Mortality Rate, and can range from 0 for no fishing to very high values such as 1.5 or 2.0.

For example, if F=1.5, then approximately 1.5/365 or 0.411% of the population dies each day from fishing. If fishing were the only cause of death, then the number of fish that survive the fishery over the year from a population of 1 million alive at the beginning of the year is 1 million multiplied by $e^{-1.5}$ or 223,130 fish. During fishing, there are other causes of death that also act on the population of fish, and these must be considered in calculating the number that die from fishing. The number that die from fishing is the proportion of the total mortality that is caused by fishing, multiplied by the number that die from all causes [i.e. F/Z multiplied by $(l-e^{-Z})$ multiplied by 1 million.] If the total mortality rate is 1.7, as given above, then this calculation is:

{1.5} over {1.7}(1-e SUP {-1.7})(1,000,000)~=~ (0.8824)(0.8172)(1,000,000)#~=~721,186~ fish~ that~ die~\from~fishing

$F_{0.1}$ - A fishing mortality rate at which the increase in yield per recruit in weight for an increase in a unit of effort is only 10% of the yield per recruit produced by the first unit of effort on the unexploited stock (i.e. the slope of the yield per recruit curve for the $F_{0.1}$ rate is only 1/10 the slope of the curve at its origin). This rate often approximates a fishing level that provides the greatest long-term average yield.

F_{max} - A rate of fishing mortality for a given exploitation pattern rate of growth and natural mortality, that results in the maximum level of yield per recruit. This is the point that defines growth overfishing.

$F_{5\%}$ - A rate of fishing for a given exploitation pattern that, on average, will produce a spawning stock biomass which is 5% of the level calculated to occur in the absences of fishing. For Atlantic sea scallops, this defines recruitment overfishing and is the basis for the overfishing definition.

Fixed Costs - Cost that neither increase nor decrease as output changes.

GRT - gross registered tons.

Groundfish - A group of bottom-dwelling fish that are often caught by otter trawls in the northwest Atlantic. The more common species in this category are listed in Table 18.

Growth Overfishing - The rate of fishing as indicated by an equilibrium yield per recruit curve above which the losses in weight from total mortality exceeds the gain in weight due to growth. This point is defined as F_{max}.

HP - horsepower

ICNAF - International Convention for the Northwest Atlantic Fisheries.

IDMDS - Inlet Dredged Material Disposal Sites

IWS - Industrial Waste Site

JVP - Joint Venture Processing; a term in the Act.

Kilometer (km) - 1,000 meters = .62 mile.

LLW - low level radioactive wastes.

Lay System - A method of dividing the gross revenues and expenses of a fishing vessel among the owner(s) and crew.

Long-Term Potential Catch - The largest annual harvest in weight which could be removed from a fish stock year after year, under existing environmental conditions. This can be estimated in a variety of ways, ranging from maximum values from production models to average observed catches over a suitable period of years.

MAFMC - Mid-Atlantic Fishery Management Council

MFCMA - Magnuson Fishery Conservation and Management Act.

MMPA - Marine Mammal Protection Act

MSP - maximum spawning potential

MSY - Maximum Sustainable Yield; the greatest long-term average yield which may be derived from a fishery resource.

Marginal Cost - Addition to total cost due to increasing output by one unit.

Meat count - The number of scallop meats making up one pound of product.

Metric ton (mt) - 2204.6 pounds.

Mortality Rate - The rate at which fish die from natural causes (disease, predation, old age) or fishing. Mortality rates can be described in several ways. Conceptually the easiest way is total annual mortality rate, the fraction of the fish alive at the beginning of a year that die during the year. For example, a total annual mortality rate of 0.50 means that 50% of the population of fish died for whatever reason during the year. In general, annual mortality rates can range from 0 to 1.0, that is 0% to 100% mortality. Note that the exploitation rate is the same as the annual fishing mortality rate.

Annual rates are easy to understand, but difficult to use when describing the relative contribution of different types of mortality, such as fishing and natural causes, to the total mortality of fish during a year because they cannot be added. One way to describe the mortality and overcome this limitation of annual rates is by using instantaneous rates, although this approach is conceptually more difficult. An instantaneous mortality rate is the fraction of the population of fish that dies in each very short period of time. The derivation of instantaneous rates is mathematically complex, but there is a relatively simple

connection between them and the simpler annual rates. Any particular instantaneous mortality rate, often denoted by Z, is equivalent to one specific annual rate A, according to the formula:

A~=~1~-~e^{-Z}

That is, the annual rate is equal to e, (this is the number 2.718, the base of the natural logarithms) raised to the negative power of the instantaneous rate, subtracted from 1.0. For example, the instantaneous mortality rate of 1.1 is equivalent to an annual mortality rate of 0.67, or 67%. In practice, instantaneous rates range from 0 to values as high as 1.5 or 2.0, but theoretically could take on any large value. Because instantaneous rates make computing the relative importance of different sources or mortality very easy (because instantaneous rates can be added), they are frequently used by fishery biologists, and are used throughout the documents. To aid in interpretation, the following table showing relationships between the simpler annual rates and the more useful instantaneous rates may be helpful:

Instantaneous Total Mortality Rate	Annual Percentage Mortality from all causes	Instantaneous Fishing Mortality Rate (M = 0.1)	Annual Percentage Mortality from Fishing
0.20	18%	0.10	9%
0.40	33%	0.30	25%
0.60	45%	0.50	38%
0.80	55%	0.70	48%
1.00	63%	0.90	57%
1.07	66%	0.97	60%
1.35	74%	1.25	69%
1.60	80%	1.50	75%
1.85	84%	1.75	80%
2.10	88%	2.00	84%
2.35	90%	2.25	87%

NEFSC - Northeast Fishery Science Center.

NMFS - National Marine Fisheries Service.

NOAA - National Oceanic & Atmospheric Administration.

National Standards - Fishery conservation and management criteria for the preparation of Fishery Management Plans in the MFCMA.

OY - Optimum Yield.

Opportunity Cost - Value of best alternative that dad to be given up in order to undertake a given course of action.

Partial Recruitment - The distribution of fishing mortality over the age composition of the fish population, determined by the type of fishing gear, spatial and seasonal distribution of fishing and the growth and migration of the fish. The pattern can be changed by modifications to fishing gear, for example, increasing mesh or hook size, or by changing the ratio of harvest by gears exploiting the fish (e.g., gillnet, trawl, hook and line, etc.).

Primary Gear - The gear used to produce the greatest annual revenue for a single vessel. This convention is used to avoid double counting on trips for which fishermen used two or more gears.

Present Value - Value of future dollars in terms of what they are worth today. The loan amount one could borrow today and pay back with the future dollars.

Producer Surplus - What producers are paid less their marginal costs.

Quota - A portion of a TAC (Total Allowable Catch) allocated to the fishery.

Real Value - Measure of value removing the effects of inflation. The value of a good (or goods) in terms of their price from some given year (called the "base year"). Also called "value in terms of constant dollars".

Recruitment - The amount of fish added to the fishery each year due to growth and/or migration into the fishing area. For example, the number of fish that grow to become vulnerable to the fishing gear in one year would be the recruitment to the fishable population that year. This term is also used in referring to the number of fish from a year class reaching a certain age. For example, all fish reaching their second year would be age 2

recruits.

Recruitment Overfishing - The rate of fishing above which the recruitment to the exploitable stock becomes significantly reduced. This is characterized by a greatly reduced spawning stock, a decreasing proportion of older fish in the catch, and generally very low recruitment year after year.

Regional Director (RD) - Regional Director for the Northeast Regional Office, NMFS.

Secretary - Secretary of Commerce.

SEIS - Supplemental Environmental Impact Statement

SMB - Squid (Illex and Loligo), Atlantic mackerel, and butterfish.

Shell stocker - Vessel engaging in scallop fishing that does not remove scallop meats from the shell before landing.

Shucker - Vessel engaging in scallop fishing that removes meat from the shell before landing.

Spawning Stock Biomass (SSB) - The total weight of all sexually nature fish in the population. This quantity depends on the abundance of year classes, the exploitation pattern, the rate of growth, both fishing and natural mortality rates, the onset of sexual maturity and environmental conditions.

Spawning Stock Biomass Per Recruit (SSB/R) - The expected lifetime contribution to the spawning stock biomass for a recruit of a specific age (e.g., per age 2 individual) such as the spawning stock biomass divided by the number of fish recruited to age 2. For a given exploitation pattern, rate of growth and natural mortality, an equilibrium value of SSB/R is calculated for each level of F. This means that under constant conditions of growth, natural mortality and exploitation patters over the life span of the species, an expected average SSB/R would result from each constant rate of fishing.

A useful reference point is the level of SSB/R that would be obtained if there were no fishing. This is a maximum value for SSB/R, and levels of SSB/R under different rates of fishing can be compared to it. For example, the maximum SSB/R for Georges Bank haddock is approximately 9 kg for a recruit at age.

Sustainable Yield - The number or weight of fish in a stock that can be taken by fishing without reducing the stock's biomass from year to year, assuming that environmental conditions remain the same.

TAC - Total Allowable catch is the total regulated catch from a stock in a given time period, usually a year.

TALFF - Total allowable level of foreign fishing; a term in the Act.

Territorial sea - The area extending 3 nautical miles seaward from the shoreline of the coastal states and under the management authority of the individual states.

Total Mortality Rate - The combined effect of all sources of mortality acting on a fish population. This is conveniently expressed in terms of instantaneous mortality rates because the total instantaneous mortality rate is simply the sum of the instantaneous fishing and natural mortality rates. For example, the total instantaneous mortality rate that is occurring when the instantaneous fishing mortality rate is 0.5 and the instantaneous natural mortality rate is 0.2 would be 0.7, which is equivalent to an annual rate of 50%.

Variable Cost - Cost of all inputs the firm increased in the short run to produce more.

Vessel Class - Commercial fishing vessels are classified according to their gross registered tons (GRT) of displacement. Vessels displacing less than 5 tons are not routinely monitored, and are referred to as "undertonnage". Larger vessels are classified as follows:

Vessel Class	Gross Registered Tonnage
2	5 - 50
3	51 - 150
4	151 - 500

Year Class (or Cohort) - Fish from stock born in the same year. For example, the 1987 year class of cod includes all cod born in 1987, which would be age 1 in 1988. Occasionally a stock produces a very small or very large year class and this group of fish is followed closely by assessment scientists since it can be pivotal in determining the stock abundance in later years.

Yield Per Recruit Analysis - The expected lifetime yield per fish of a specific age (*e.g.*, per age 2 individual). For a given exploitation pattern, rate of growth and natural mortality, an equilibrium value of Y/R is calculated for each level of F. This means that under constant conditions of growth, natural mortality and exploitation patterns over the life span of the species an expected average Y/R would result from each constant rate of fishing.

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